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IMPULSIVITY/REFLECTIVITY: ITS RELATIONSHIP TO CONCEPTUAL BEHAVIOUR IN CHILDREN

by

Stephanie Ann Mitchell

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Impulsivity/Reflectivity: It's Relationship to Conceptual Behavior in Children submitted by Stephanie Ann Mitchell in partial fulfillment of the requirements for the degree of Master of Education.

DEDICATION

to my mom and dad

Abstract

The conceptual system is a means through which complexities of our physical and social environment can be reduced into smaller chunks to facilitate ease of interpretation and understanding. Based on research findings which report conceptually impulsive subjects have poor academic achievement, to be more aggressive, over-controlled, constricted, dogmatic, having little tolerance for complexities, to demonstrate rigid behavior, overconfident in reacting, and less able to integrate information as necessary to solve a conceptual problem, it has been hypothesized in this study that impulsive children conceptualize at lower levels of conceptual development than do reflective children. A review of literature regarding hierarchies of dimensional preferences relating to perceptual inclinations of children as it relates to the conceptual process is also presented.

The study was conducted with 60 grade four students within the Edmonton Public School District. Tests used included the Matching Familiar Figures Test as a measure of conceptual tempo, the Canadian Cognitive Abilities Test as a measure of I.Q., a Dimensional Preference Test, and two measures of conceptual levels: The Vygotsky Concept Formation Test and the Klausmeier Conceptual Learning and Development Assessment.

Hypotheses tested were that reflective children would perform better than impulsive children on the conceptual tasks and would demonstrate dimensional preferences for dimensions which occur earlier in the developmental hierarchy

as reported in the literature. The hypotheses were tested by means of t-tests to ascertain if significant differences between impulsive and reflective groups existed on each of the measures. Stepwise regression with cross validation was also used to assess which of the variables acquired the greatest power in defining group membership (impulsivity/reflectivity).

Results of the study indicated that reflective children, compared with impulsive children, tend to respond to dimensional preferences occurring later in the developmental hierarchy, and demonstrate conceptual skills reflecting more advanced levels defined in terms of Vygotsky's and Klausmeier's theories of concept formation.

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I. Introduction

A. Rationale for the Study

A basic human goal central to many psychological theories is the conceptual organization of thinking and behavior which facilitates our continuous adaptation to a changing environment. In an environment which is becoming increasingly more technical, complex, and fast-moving, it becomes concomitantly more important to facilitate understanding and interpretation of our physical and social world. This is accomplished, in part, through the use of concepts which serve to reduce the overwhelming amount of information around us into smaller, meaningful chunks. Conceptual systems develop throughout the growth process mediating and serving as a premise from which attitudes, values, and beliefs are based and serving as a foundation from which an individual goes about learning, coping with, and adapting to his environment. In Klausmeier's (1979) words,

> Attaining concepts at increasingly higher levels and gaining a more complete understanding of the principles that express relationships amoung concepts enable the individual to interpret the physical and social world with greater economy, accuracy and elegance. Continuously organizing sets of related concepts and principles into more comprehensive conceptual cores permits persons to acquire, organize, store, and retrieve greater amounts of information. (p. 67).

The primary area of focus for this study was conceptual tempo as a specific aspect of the conceptual system as a whole. This study emanated from a survey of the literature on the topic of conceptual tempo. The notion of

conceptual tempo was first discussed by Kagan et al (1964) as an alternative explanation for individual differences in problem solving abilities which could not be attributed to intelligence factors. While intelligence factors were equal, some individuals displayed a greater facility than others for deriving a correct solution to a conceptual problem in which several possible alternatives were present, and there was a degree of ambiguity as to which of the alternatives was correct. Kagan (1964) noted that with consistency, those individuals whose choices were incorrect tended also to formulate their responses more quickly than those individuals whose responses were correct.

The literature reveals a myriad of differences between these two groups labelled impulsive and reflective, most of which lead to the conclusion that conceptually impulsive individuals, as compared with conceptually reflective individuals perform more poorly on a variety of measures. In essence, impulsive individuals appear less able to accurately cope with stimuli within the environment for the purpose of solving a conceptual problem. It appears reasonable to suspect the impulsive individual does not have the comprehensive conceptual core which facilitates the acquisition, organization and retrieval of greater amounts information which would enhance his adaptive potential.

The thesis begins with some basic ideas regarding the conceptual process which appears in the last part of this chapter. This is followed by an overview of two theoretical models of concept formation in Chapter Two: Klausmeier's

and Vygotsky's. Chapter Three contains a review of the literature on various aspects of inpulsivity/reflectivity (i.e., as it relates to academic achievement, personality, development, dealing with ambiguity, locus of control, response latency, processing strategies and reversal-nonreversal shift performance) as well as a review of literature on dimensional preferences of children (i.e., hierarchies, and the ability to integrate dimensions in solving a conceptual problem). Dimensional preferences reflect perceptual tendencies and as such also represent an aspect of the conceptual system.

Based on similarities which appear to exist between impulsive children as revealed through the literature on conceptual tempo and characteristics of early stages of conceptual development relative to Klausmeier's and Vygotsky's theories, the intended purpose of the study was to investigate differences in levels of conceptual development which may exist between conceptually impulsive and reflective children. A further purpose was to determine if there are differences in the dimensional preferences to which impulsive and reflective children respond more readily which may also reflect differences in level of conceptual development within Klausmeier's and Vygotsky's theories.

B. The Conceptual Process

The evolution of concepts in our developmental ontogeny enables us to "code things into a smaller number of categories and thus simplify the

environment to some degree" (Bourne, 1966). Klausmeier et al (1974) define a concept as "ordered information about the properties of one or more things--objects, events, or processes--that enables any particular thing or class of things to be differentiated from and also related to other things or classes of things " (p. 4). The role of concepts as viewed by Kagan (1966) is as symbolic mediators which are "as distillate of sensory experience and the vital link between external inputs and overt behaviors" (p. 97). Vygotsky (1962) adds to this that language plays a vital role in that it directs mental operations and channels them towards the advanced process of concept formation.

The combination of developmental readiness and environmental experience allows for the acquisition of concepts. Initially unaware of the concept of roundness, for example, a child gradually becomes acquainted with different instances of the concept until he is able to spontaneously generalize or to isolate and name the concept accurately in the presence of other noninstances of the concept. The gradual acquisition of the concept is referred to as concept formation or concept acquisition, while the ability to correctly identify the concept in any given situation may be referred to as concept utilization.

Our environment contains a seemingly infinite array of stimuli or stimulus objects which if seen as discrete entities would relegate the world entirely incomprehensible. Concepts are reductions of the otherwise overwhelming number of stimuli into categories. One category, for example, is the concept of colour;

the infinite stimuli we perceive visually are reduced to a single, simple category by mediating the stimuli with the meaningful concept of colour.

There is, of course, variance between stimuli which exists in a category. Within a broad, initial concept or category, two additional increments help to further reduce the information: one is the notion of dimensions within the concept, and the other of values or attributes which exist along the dimension. For example, in the concept of blue circle there are two specifiable relevant dimensions: colour and shape. In the dimension of colour, blue is a single value or attribute which lies somewhere along an infinite spectrum of colour; in the dimension of shape, circle is a single value or attribute which exists among many different values of shape. All of those values on the dimension of colour which are noninstances of blue, and all of those attributes or values on the dimension of shape which are not circles are irrelevant to the concept of blue circle. Only colour and shape are relevant dimensions to the concept, and only blue and circle are relevant values along those two dimensions.

The process of acquisition of concepts through awareness and attention to specific categories of objects, dimensions and values along those dimensions, and the subsequent utilization of those concepts, culminates in the conceptual behavior. A part of this conceptual process was the intended focus of this study.

II. Structural Models of Conceptual Behavior

A. Klausmeier

Klausmeier's (1974; 1979) model of conceptual learning and development (CLD) is organism-centered and further premised upon the essential dynamic interaction between an individual and his environment. This interaction results in learning which Klausmeier regards as the impelling force of conceptual development, and it is conceptual learning which is the ultimate determinant of overall cognitive development. This is at variance with the widely held Piagetian view of concept attainment in that emphasis is not as heavily dependent upon maturational variables. Maturtion is taken into account by Klausmeier in an unspecified manner, but it is second to learning principles in the credit it acquires as a factor in conceptual development. Concepts and problem-solving abilities are the outcomes of learning primarily and maturation secondarily.

Four different, successively higher levels of concept attainment are hypothesized by Klausmeier. The information processing conducted at each level becomes progressively more highly differentiated and abstract. Further, he logically postulates that these levels are essentially invariant stages in the development of each single concept an individual acquires rather than necessarily being invariant stages linked exclusively to maturational variables. Since learning experience is the primary requisite for determining a given level of conceptual

ability, it is possible to be at different levels of development for different concepts at the same time. Conceivably, for those concepts in which a learner has had a lot of experience, the level of processing will be higher than it will be for those concepts in which he has had little experience. The overall picture portrayed is one in which an individual through learning acquires a set of concepts all of which may coexist at various levels of development as a function of that individual's experience or interaction with his environment.

The four levels of concept attainment outlined by Klausmeier (1974) are concrete, identity, classificatory, and formal. A dynamic interaction between the individual and his environment results in learning, and the essential tools of learning Klausmeier refers to as 'operations'. At all four levels three specific operations are ongoing: attending, discriminating, and remembering. Beyond the first two levels at the classificatory and formal levels three more operations are added: generalizing, hypothesizing, and evaluating. Characteristics of the four stages are as follows:

Stage 1: Concrete. At the concrete level of concept formation the child can only attend to the distinctive features of and form a mental image of an object. He is able only to distinguish the object from other objects and represent his awareness internally.

Stage 2: Identity. At the identity level, the child is now able not only to attend to and form a mental image of the object, but he is also able to

cognize that same object when it is observed from a different perspective or through a differrent sense modality. For example, the child is now able to recognize the table is continuous and still remains the table no matter from what angle--top, bottom, side--it is viewed.

Stage 3: Classificatory. When the individual becomes able to treat two or more instances of the same object as equivalent, he has attained the classificatory level. He is now able to identify examples and nonexamples, of a class, or to generalize his cognizance of an object. While he is able to identify examples and nonexamples, he may not, at this level, be able to describe the reason for his grouping by identifying the defining attributes of the group.

Stage 4: Formal. The individual is now acquainted with and can name the intrinsic or societally accepted defining attributes of a concept. He can name the concept, identify instances and noninstances, and can describe the basis for inclusion or noninclusion by identifying the defining attributes. The individual is now able to evaluate new, previously unencountered instances by comparing the new instances with the defining attributes.

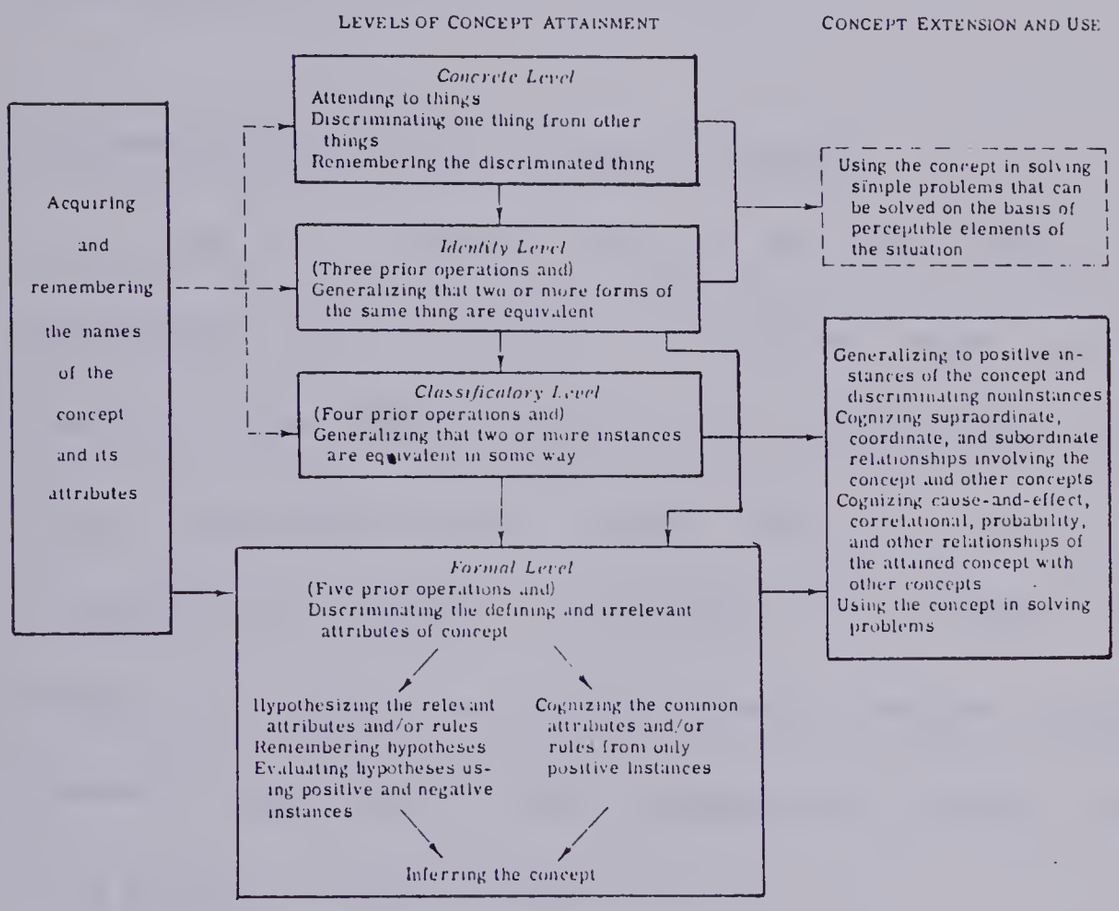
Table 1 depicts Klausmeier's model of conceptual learning and development.

Insert Table 1 Here

In summary, an individual at the concrete level discriminates objects in a global, diffuse manner; at the identity and classificatory levels the individual

TABLE 1

Model of Conceptual Learning and Development



(Klausmeier, 1974, p. 13)

begins to pay attention to more specific and abstract properties of the object and can, thereby, at the classificatory level begin to generalize; finally, at the formal level the individual, having attended to the specific properties, can now go one step further to consciously label and define all the attributes of the concept. This provides the necessary requisites for a thorough evaluative processing ability.

B. Vygotsky's (1962) Theory of Concept Formation

At the root of Vygotskian theory is the central conviction that human communication with the tendency to gravitate toward expressions of progressively higher psychic functions is only possible because "man's thought reflects 'conceptualized' actuality." (Vygotsky, 1962, p. 7). Man has the capacity to transcend the immediacy of his sensations or perceptions by mediating perception and thought to generalize beyond immediate reality. Through experimental study, Vygotsky (1962) investigated and developed a stage theory of the process of concept formation.

Dynamic interaction between the internal developing processes of an individual and the external social and cultural environment provides the potential for conceptual growth.

> The investigator [anyone undertaking to study concept formation] must aim to understand the intrinsic bonds between external tasks and the developmental dynamics, and view concept formation as a function of the adolescent's total social and cultural growth, which affects not only the contents but also the method of his thinking. (p. 59)

According to Vygotsky, functions which would facilitate internal processes necessarily include attention and perceptual awareness; an ability to differentiate and associate aspects of perception or to analyze discrete elements within the environment; an ability to abstract relevant elements and to generalize beyond the concrete, immediate experience; to be able to reunite abstracted information as a synthesized concept. The single indispensable link upon which all of these functions are dependent is language. Words are the essential symbols for thought and a vehicle for communication of thought. It is through the use of language that an individual is able to exert control and direct his own thoughts toward efficient problem solving and to achieve higher forms of communication.

There are three phases, each containing within them several stages, which Vygotsky postulates form the ontogenetic developmental sequence of an individual's ability to formulate concepts.

Phase 1, Syncretic Thinking. In this earliest phase of development, thinking is primarily characterized by a lack of organization (syncretic conglomerations) and a propensity to establish unity or associations between objects on the basis of subjective image impressions. Meanings of words, for example, may be linked inaccurately to several objects in accordance with vague, diffuse extensions of meaning, consequently creating unstable images.

(a) Trial and error stage. At this, the earliest stage, groups of objects are established totally by guessing. Grouping occurs randomly.

(b) Visual field stage. The child organizes objects according to elemental contiguity in space or time. Grouping occurs to the child as a result of the objects' spatial and/or temporal position.

(c) Regrouping stage. The only difference between this and the previous two stages is that the child, having formed a grouping either by (a) or (b) now regroups the objects in his attempt to seek more meaning; the process is a two-step operation. This effort, however, still results in a syncretic, basically unorganized grouping.

To summarize, the syncretic phase amounts to a coalescence of objects into "heaps" bearing little relationship to what may be said to exist in reality. The basis for group formation is relevant to the child's own subjective impressions and outwardly appears to lack coherence.

Phase II, Thinking in Complexes. A complex is "a concrete grouping of objects connected by factual bonds." (Vygotsky, 1962, p. 62). The child begins to move toward objective thinking in this phase in that he now recognizes the concrete, factual properties between objects. Although still tending to be compelled by subjective impressions, he is less egocentric and can make associations establishing relationships between objects based on fact. These factual bonds between objects are a direct result of the child's experience.

(a) Associative complex. The child begins with a nuclear object and then forms associations with whatever similarities he perceives an object to

have to the nuclear object. One object may be the same colour as the nuclear object, another may be the same shape, but not the same colour, and still another may be the same size as the nuclear object, for example. The group as a whole,however, does not have one single unifying bond.

(b) Collective complex. Collective complexes are still associative complexes; however, they are built upon contrasts rather than similarities. For example, if colour is to be the basis for association, the group is likely to be a "collection" of different colours.

(c) Chain complex. During this stage the child establishes bonds which are serially linked. Once a bond is established between two objects on the basis of colour, perhaps, the child then begins to look for other members to fit the group and may notice that a non-member is the same shape as one of the objects in the group. Attention is then shifted from the attribute of colour and the new criterion becomes shape. There is a constant shifting of this nature such that all the chosen objects are similar to at least one other object in the group. The creation of bonds is chain-like as a result of the shifting criteria.

(d) Diffuse complex. Bonds are formed on the basis of vague, unstable attributes. For example, when an initial object is a triangle, the child may then choose a trapezoid which is similar to a triangle in most respects, but has a chopped-off top. Squares might also be included because of their vague

similarities. The criteria for grouping at this stage are characteristically diffuse in nature.

(e) Pseudo-concept. A pseudo-concept resembles a true concept in that the end product is the same as one which was formed on the basis of an abstract concept. In reality, the child has actually formed the group because of concrete, perceptual bonds rather than abstract concepts, so it is the means rather than the end which signifies the difference between a psuedo-concept and a concept.

In summary, the function of thinking in complexes is to provide a child experience at recognizing perceptual bonds and making associations based on perceptions. Thinking in this phase is limited for the following reasons: (a) associations may be unstable and diffuse as a result of reliance on subjective perceptual impressions still carried over from phase I; (b) thinking is highly bound to concrete images; (c) the child is limited in his ability to selectively attend to relevant dimensions and may group according to any and all attributes which may occur to him at any given time.

Phase III, Conceptual Thinking. Once the child has developed an ability to organize the elements into some coherent, fact-based pattern, he then tightens the organization by beginning to abstract only essential relationships and can, hence, make generalizations. He is able to transcend the immediacy of his perceptual experience and uses the processes of both analysis and synthesis.

Again, Vygotsky describes several stages in the development of conceptual thinking.

(a) **Maximally similar grouping stage.** The child forms groups by abstracting the attributes that are most similar from all the possible attributes. He focusses selective attention upon these abstracted "best fit" attributes. Some attributes are ignored, yet thinking in this stage is still limited in that traits are vaguely formed and still tend to appear subjectively derived.

(b) **Potential concepts.** The next step in the process is to identify a group on the basis of a single attribute, i.e., colour. The product of a potential concept, as with pseudo-concepts is the same as for a true concept. However, because the bonds for pseudo-concepts are merely associations emanating from perceptual experience, they are unstable. The associations are used to make generalizations which unite objects. Conversely, potential concepts, based on complexes, are more stable in nature. Attributes, having been abstracted, are less likely to become lost or yielded to other perhaps more salient dimensions.

(c) **True concepts.** Once attributes have been abstracted, the individual synthesizes them to form genuine concepts. Essentially, genuine concepts encompass all preceeding phases and are a restructuring of information such that parsimoneous meaning is derived beyond the immediate circumstances in the form of a concept. The thought processes embodied within the concept are symbolized by a word.

C. Synthesis of Theories of Concept Formation

Klausmeier's and Vygotsky's early stages of conceptual development would seem to be in agreement that there is an inability to form concepts at all. Klausmeier's first two stages explicitely refer to functions of attending and forming mental images of objects. Vygotsky also refers to these functions of attending and perceptual awareness, but includes differentiation or an ability to detect discrete elements of the environment as early processes. Vygotsky goes further to describe attempts at concept formation as being founded upon inconsistent perceptions and vague ideas such as contiguity of space. Essentially, then, early stages of concept formation are merely the development of functions which will ultimately be used to facilitate concept formation.

Once these functions have been developed, true concept formation begins to emerge. The individual, already able to discriminate attributes and identify objects, is now able to generalize and identify examples and nonexamples of those objects and to begin to classify (Klausmeier). Again, Vygotsky goes further in his description of concept formation at this stage noting how bonds are established in this classification process: i.e., associations of single objects to a nuclear object based on similarities or differences, serial association, or vague, unstable bonds such as trapezoid/triangle associations.

Limitations of this stage within Vygotsky's model are that the individual is bound to concrete images which are linked with subjective perceptual

impressions: selective attention to relevant dimensions is sometimes hampered due to over-reliance on subject perceptions--more salient dimensions, for example, may erroneously captivate and divert attention. The fact that bonds are more perceptually than conceptually created seems explained by Klausmeier in saying that even though an individual at this stage can now, with reasonable accuracy, identify examples and nonexamples of a class, he may not be able to provide a conceptually formulated explanation for his grouping.

The final stage of development is characterized by a shift in emphasis from reliance upon perceptual elements toward utilizing cognitive processes. The individual is now able to cognitively evaluate his perceptual experience and to abstract from it relevant dimensions. Klausmeier's model identified evaluating and hypothesizing as special abilities of this stage, while Vygotsky refers to the processes of analysis and synthesis. Essentially, they would appear to be getting at the same idea in that the individual can now collect and process a large amount of information through analysis or evaluation and can reduce that information to make it more meaningful through the process of synthesis and the development of hypotheses.

III. Review of the Literature

This chapter begins by defining conceptual tempo and then provides a review of literature on various aspects of impulsivity/reflectivity (i.e., as it relates to academic achievement, personality, development, dealing with ambiguity, locus of control, response latency, processing strategies, and reversal/non-reversal shift performance) as well as a review of literature on dimensional preferences (i.e. hierarchies of preferences, conceptual behavior relevant to hierarchies, and the ability to integrate dimensions in solving a conceptual problem). Implications for research and the research objective are then discussed followed by specific purposes and hypotheses of the study.

A. Conceptual Tempo: Impulsivity/Reflectivity - Defined

Impulsivity/reflectivity is generally defined by reference to two factors: response time or latency period and number of errors. The Matching Familiar Figures Test (MFFT) developed by Kagan et al (1964) has been established as a prototype for delineating these two groups. The test involves selecting one picture from six plausible alternatives which is exactly like the standard model presented. All six alternatives appear the same as the standard at first glance; each alternative, a picture of a ship, for example, is the same general size and shape, but five of the alternatives vary along some minor, not readily discriminable dimension such as the number of smoke stacks; only one

alternative is exactly the same as the standard. The subject is required to survey all the dimensions and values in the alternatives and compare them with the standard to assess their equivalence. Using a double median split (median for the latency period and median number of errors) two distinct groups emerge: fast-inaccurate, or impulsives and slow-accurate called reflectives.

B. Impulsivity/Reflectivity - Review of the Literature

Academic Achievement. David Barrett (1977) a study to assess the academic achievement level of impulsive and reflective grade four students. He also was interested in determining the efficacy of using the Matching Familiar Figures Test (MFFT) as an instrument for educational placement of decision-making. Using the MFFT and the Comprehensive Test of Basic Skills (CTBS), he ascertained that reflectives achieved significantly higher on the CTBS than impulsives; however, in a follow-up study these results did not prove consistent over time: those children identified as reflective no longer scored significantly higher than impulsives at the grade five and six levels. Although poor academic achievement appears to be a concomitant of impulsivity, an impulsive tendency does not seem to be a fixed variable. Barrett has pointed out that it is not efficacious to use the MFFT for the purpose of making placement decisions; the achievement measure itself (CTBS is a better predictor of future academic success.

Personality Correlates. While poor academic achievement tends to be associated with an impulsive conceptual tempo, so do several personality variables which may engender a maladaptive disposition to a problem-solving task.

Messer and Brodzinsky (1979) found that impulsives who tell more aggressive stories are more likely to act on their impulses than were reflectives. Block and Peterson (1955) were quite adamant in their assertions about impulsives finding them to be overcontrolled, constricted, blustery, and dogmatic, with little tolerance for complexities of everyday problems. They implied that impulsives felt a need to save face, and this fostered rigid behavior. Although appearing overconfident in responding, impulsives lacked self-reliance and independence in their judgment; they were found to be stimulus-bound, diffuse in reaction, and appeared "startled" into responding in order to cope with the stress of the situation.

Block, Block, and Harrington (1974) found impulsives to be comparatively brittle, less resourceful, more anxious, hypersensitive, vulnerable, and most importantly, structure-seeking. The suggestion made about impulsives was that they were more suceptible to anxiety because of their character structure; consequently, they were given to an impulsive tempo which was reflected in their behavioral deficiencies.

Charles Smock (1955) presented subjects with a partially-structured perceptual field asking that they identify what was contained within the field reporting the correct response as soon as possible. Smock discovered that subjects in a stress situation tended to respond before adequate information was available; they structured and reached closure prematurely. Smock hypothesized that stress results in an inability for some individuals to withhold a response until adequate information is available to complete the field array. Mitchell and Ault (1979) also found impulsive subjects tend to offer a solution on a pattern matching task before they had sufficient information to perform the task accurately.

Messer (1970) explored the effects of anxiety on the tendency to be reflective or impulsive. Messer induced anxiety in his subjects experimentally by having them fail a task and found that the induced anxiety resulted in a longer decision time for both reflective and impulsive subjects. Further, it resulted in fewer errors for impulsives. Messer hypothesized that concern about the quality of one's performance is an antecedent of a reflective disposition.

In contrast, a more recent study (Moore, Haskins, and McKinney, 1980) looked at the classroom behaviors of impulsive and reflective children. Specific behaviors observed included iindependent work, attending, distractability, extent of interfering behavior, aggression, time spent talking to the teacher (task related and social), or peers (task related, social, or arguing) or self, amount of

nonfunctional movement (i.e., rocking, pencil tapping). The authors found that impulsives and reflectives were virtually indistinguishable on the basis of these criteria and concluded that classifying children with an impulsive conceptual tempo as children who would habitually behave in "impulsive" ways was really an unsupportable overgeneralization. They further concluded that conceptual reflectivity/impulsivity does not necessarily imply behavioral or personality differences.

Development. Another issue treated in the literature is that of the developmental nature of impulsivity/reflectivity whereby impulsivity appears to be an earlier stage of development and reflectivity a later stage. Adams (1972), using a problem-solving task assessed search strategies between children at two different age levels; six and eight years of age. Results showed that the reflective subjects used developmentally more mature guessing strategies than the impulsives; young (six year old) reflectives performed at a level similar to that of seven to nine year olds, whereas young impulsives performed at a level similar to that of five to seven year olds. In a similar study, Ault (1973) also found young reflective subjects asked task related questions which were equivalent to those asked by older impulsive subjects. This more efficient question asking behavior was also verified by Denny (1973). The implication made was that older impulsive subjects' question-asking behavior seemed developmentally similar to younger reflective subjects. Reflectives also tend to

demonstrate more mature strategies for dealing with information within the visual-spatial realm (Brodzinsky, 1980).

Finally, Nuessle (1972) concluded that developmental differences in focusing are related to developmental differences in reflectivity/impulsivity, and that it was likely a reflective cognitive tempo facilitates focusing because it allows for more effective retrieval and recoding of information.

Dealing with Ambiguity. Ironsmith and Whitehurst (1978) asked Kindergarten, first, second, fourth, and sixth grade children to choose one of four pictures based upon a speaker's message. The messages were either informative providing enough information to choose the correct referent, or they were ambiguous. The children were told to ask questions if they needed more information. Results showed that Kindergarten children have difficulty detecting ambiguity, second graders, while detecting ambiguity that one message had two referents, had difficulty isolating the distinguishing characteristics of the two referents, and fourth and sixth graders were not able to perform these two analyses well. These results lead to the implication of a progressive ability to make clear differentiations, and that without the ability to make adequate differentiations, steps (appropriate question in this case) cannot be formulated to clarify that ambiguity. Margolis, Leonard, Brannigan, and Heverly (1980) similarly noted that impulsives more than reflectives performed less well when confronted with ambiguity. Their study was designed to address the hypothesis

that tasks identified as being high in response uncertainty would be the best predictors of impulsivity. Kindergarten children were tested on several measures varying from high to low in the degree of response certainty (i.e., Wepman Auditory Discrimination test was judged to be high in response uncertainty for the subject, while the WISC-R digit span subtest was considered low in response uncertainty). Findings yielded the results that impulsives are less able than reflectives to deal efficiently with tasks in which there is a high degree of uncertainty. Degree of response uncertainty was found to be a good predictor of impulsivity.

Locus of Control and Field Dependence/Independence. Locus of control and the concept of field dependence versus independence contain the idea of the distinction between self and other. Both Messer (1972) and Shipe (1971) investigated impulsivity and the propensity toward an internal or external locus of control. The findings were that impulsive individuals experience less sense of control over their own destiny, or, in other words, impulsives have a sense that control of their destiny emanates externally from sources over which they can exert no control.

Enforced Response Latency. Studies conducted to enforce a response latency for impulsive subjects reveal this has no effect upon altering error rate (Kagan, Peterson, Welch, 1966; Heider, 1971; Zelnicker, Cochavi, and Yered, 1974). In contrast, teaching strategy was found to decrease error rate (Heider,

1971).

Processing Strategies. Studies conducted to enforce a response latency for impulsive subjects reveal this has no effect on altering error rate; however, scanning strategies investigated in the literature provide the most direct support for the contention that problems associated with conceptual tempo may be more readily identifiable with a defective initial process upon which all concept formation depends. Several findings generate a profile of the impulsive which leads to this conclusion.

Ault, Crawford, and Jeffrey (1972) examined the strategies of twenty-nine children between third and fourth grade. Although they found the basic scanning strategy to be the same in that all subjects employed the strategy of comparing the standard with the variants, they discovered that reflective subjects attained lower error rates by spending a larger proportion of their fixations in returns (paired comparisons between the standard and one variant or between two variants). Impulsives were less systematic and thorough making fewer such comparisons.

Similar results in observing scanning strategies were obtained by Drake (1970), Kagan (1966), and Odom et al (1971), and Seigel et al (1973). Reflective subjects looked at a larger proportion of the stimulus array in greater detail making twice as many comparisons between homologous parts of different figures (Drake, 1970). Drake hypothesized that the subjects adhered to one of

two rules in deriving their solution: (1) they looked for differences between variants and the standard and chose a variant only if they failed to find any difference between it and the standard; (2) they looked for differences between variants and the standard and eliminated deviant variants until only one variant remained. The second alternative was the more efficient for successful task solution. Reflective subjects were more apt to employ this rule viewing all variants before offering a response (Drake, 1970).

Brodzinsky's (1975) study was designed to examine the relationship between children's conceptual tempo and their ability to comprehend and appreciate cartoon humor varying in cognitive and affective salience. He tested three different age groups of impulsive and reflective children: six, eight, and ten year olds. Cartoons were classified into four categories: (1) visually-determined, low-affectivity; (2) visually-determined, high-affectivity; (3) conceptually-determined, low-affectivity; (4) conceptually-determined, high-affectivity. The findings were as follows. Humor comprehension and appreciation varied with conceptual tempo for the six and eight year olds. Reflective subjects showed significantly more comprehension. Impulsive subjects displayed greater spontaneous mirth, particularly toward the highly affective cartoons. Impulsives exhibited a decrease in performance in cartoons which required conceptual determination. Brodzinsky hypothesized this may be due to their being misleadingly attracted to the most salient, irrelevant cues rather than

the less salient, relevant cues. Arising from this misleading attraction was a distorted analysis of the cartoon.

Gardiner (1961) distinguished between the minimal scanner who tended to view the field in a global, unarticulated manner, and the extensive scanner who manages to deploy attention more articulately beyond the initial anchoring objects in the field. Gardiner (1961) also distinguished differences in orienting movements of the subject's eyes (field articulation), and found that those subjects low in their ability to clearly articulate the field were unable to attain a differential response to parts of a stimulus containing conflicting information. They were misled by irrelevant cues being relatively inefficient at attending to the relvant cues.

Another type of strategy employed in the solution of conceptual problems is the formulation and utilization of hypotheses. A recent study (Tumblin and Gholson, 1981) exployed conceptual learning through a number of different variables among which hypotheses (types and acquisition of) as well as conceptual tempo were two. Conclusions of the study found that younger children frequently get caught up in a "response-set" when attempting to develop hypotheses and tend to become insensitive to feedback which would aid in problem-solving. Older children and adults were more able to efficiently use feedback. The authors suggested these characteristics of hypothesis development reflected a developmental continuum for the most part; however, it

was also noted that significant differences were apparent between impulsive and reflective subjects generally in that reflective subjects' performance was superior in conceptual problem-solving.

Reversal/Nonreversal Shift Performance. Kendler and Kendler (1962) theorized that a qualitative change in mental processing occurred as an individual became older. The change was that gradually an internal bridge developed acting as a conceptual mediator between stimulus and response. They supported this theory by elucidating the reversal/nonreversal shift phenomenon.

Given two different dimensions--size and colour--and two different values along each of those dimensions--for size, large and small; for colour, black and white--the task would be set up as follows. In the reversal shift if the large size object were identified as the relevant dimensions for solving the task then any shift programmed into the task would remain within the dimension of size. A reversal shift would involve changing the correct response contingency from large sized object to small sized object. In the nonreversal shift, the shift is *not* along a value within the dimension, but is a shift from one dimension to the other. In this example, one of the values of colour would now be the relevant dimension.

The theory holds that older children and adults think or conceptualize the problem before they act; all the elements are mediated first. For this reason, the reversal shift is easier to learn by virture of the fact there is less

information to mediate for the older child and adult. For the younger children the inference made is that they do not use this mediational strategy. While they may be fully able to attach labels to the relevant dimension, they tend to respond first and then label or perform the two functions simultaneously, while the older child and adult will label first and then respond.

Peters (1979) explored the shift behavior of reflective and impulsive second grade girls. Both groups of girls had the same I.Q. range and were the same age; yet, the findings revealed that the reflective girls made a significantly higher percentage of reversal shifts than the impulsive girls. Peters attributed this to the reflective's greater facility for detailed visual scanning compared with the impulsive's diffuse, global strategy.

C. Dimensional Preference

The following review of literature on dimensional preference falls into three categories: the existence of hierarchies of preferences of dimensions; the types of behaviors which may be expected to exist on the basis of those hierarchies; the genesis of patterns for integrating dimensions generating more accurate conceptions of the world. A sequence of development giving rise to greater conceptual complexity and greater adaptability to new situations emerges.

Dimensional Preference Hierarchies. The literature clearly reveals there is a hierarchy of dimensionsal preferences which exists and changes with time.

Suchman, Rosslyn, and Trabasso (1966) studied the stability of preference for colour and form in children ranging from 2.10 to 6.1 years and found that the two youngest groups of six different groups (age range from 2.0 to 3.11 years) tended to prefer colour over form. The four remaining older groups (age range 3.12 to 6.10 years) showed an increasing preference for form over colour.

Odom and Guzman (1972) studied children's preference across four different dimensions: colour, form, number, and position. They established eight orderings of the four dimensions in the following way. .

(1) form, colour, number, position

(2) colour, form number, position

(3) colour, form, position, number

(4) form, colour, position, number

(5) number, form, colour, position

(6) number, colour, form, position

(7) form, number, colour, position

(8) number, form, position, colour

Hierarchies of preference emerged when the children were tested. Position was the least preferred dimension for all groups, while three dimensions acquired age-related significance. The first four arrangements each contained the dimension of colour and form in the first and second positions,

while in the last four arrangements either colour or form was arranged with number in the first and second positions. It was found that the two younger groups reflected hierarchies which took the first four arrangements into account; older groups showed preference for the final arrangements in which number was in one of the first two positions. Mitler and Harris (1969) state a decrease in preference for colour and an increase in preference for number with age.

The implication for a hierarchy of unidimensional preferences is that the order of preferences influence the order of selection and learning of different dimensional concepts. Suchman and Trabasso (1966) found that young children tended to solve conceptual problems involving more than one dimension on the basis of a single, preferred dimension. They concluded that an important factor in concept learning is the congruency between the task-relevant dimension and the child's preference. This is supported by Rollins and Castle (1973) and Toppino, Lee, and Shisko (1979) who found that the difficulty of a task is directly related to dimensional preference. Those subjects for whom the preferred dimension was relevant in the task solved the task in one-half the time it took subjects for whom the preferred dimension was irrelevant. Johnson, Warner, and Silleroy (1971) noted that this is most clearly evident for younger children and decreases with age. Further, it was suggested (Johnson, Warner, and Silleroy, 1971) that this may result because of the younger child's

inability to inhibit responding to the dominant cues. What this implies, in terms of the preceding theories, is a proclivity for processing information unilaterally; one dominant dimension captivates precluding simultaneous attention to more than one. It also reflects how earlier stages of development are characterized by external control. The children were, in fact, controlled by that one unilaterally salient, external dimension.

Conceptual Behavior Relevant to Preference Hierarchies. It was found that pretraining on the nonpreferred dimension was effective in developing an ability to solve multidimensional tasks (Mitler and Harris, 1969; Johnson, Warner, and Silleroy, 1971; Rollins and Castle, 1973; Silleroy and Johnson, 1973; Toppino, Lee, and Shishko, 1979). In the Rollins and Castle (1973) study, subjects with pretraining on the nonpreferred dimension solved the task with the nonpreferred dimension relevant more quickly than with the preferred dimension relevant; pretraining on the preferred dimension had little effect. Johnson, Warner, and Silleroy (1971) found this to be the case even when positive reinforcement schedules were used in an effort to counter the effect; pretraining had a beneficial effect on capacity to utilize the nonpreferred dimension.

Pretraining on nonpreferred dimensions was effective for younger groups--Kindergarten--but not older groups--grade three students (Toppino, Lee, and Shishko, 1979; Silleroy and Johnson, 1973). Silleroy and Johnson suggest

that younger children come into the task with strong biases; older children, on the other hand, are less dominated by preferences, and, consequently, are less amenable to improvement. Toppino, Lee, and Shishko (1979) suggest that older children have attained a general attention switching strategy which facilitates their capacity to deal in the nonpreferred dimension.

Reversal and nonreversal shift performance further elucidates patterns of behavior based on dimensional preferences. Relevant findings related to dimensional preference and reversal nonreversal shift performance are as follows: two-thirds of all colour-preferring subjects made nonreversal shifts; they readily chose the nonpreferred dimension when it was randomly reinforced; subjects who preferred colour made mostly nonreversal choices, whereas those who preferred form made mostly reversal choices (Trabasso, Stave, Eichberg, 1969); younger children made nonreversal (extradimensional) responses faster than reversal responses, while older children made reversal responses faster than nonreversal (Smiley and Weir, 1966; Caron, 1969).

In the reversal nonreversal shift phenomenon, adults and older children learn the reversal shift more rapidly than they do the nonreversal shift, while young children learn the nonreversal shift more rapidly than the reversal shift (Kendler and D'Amato, 1955; Kendler, Kendler, and Wells, 1960). If a task is set up such that the dimension of height is the relevant dimension for task solution and that tallness, for example, is the value of that dimension that is relevant, a

reversal shift would be that the height dimension would contine to be the relevant dimension, but the value along that dimension would be reversed to smallness. In the nonreversal shift, the shift that is made is to a completely different dimension so that, for example, if height was the relevant dimension, colour might now be the relevant dimension to solving the problem. The theory related to adults learning the reversal shift more rapidly than younger children, while younger children learn the nonreversal shift more rapidly is that adults mediate the problem conceptually and young children respond in an S-R manner. In order to conceptualize the reversal shift the adult must recognize that smallness and tallness are different values along a continum of the dimension of height; to conceptualize the nonreversal shift, the adult must recognize this, plus recognize there is another dimension besides height that must be taken into account, namely colour in this example. There are fewer tasks to attend to in the nonreversal shift. Consequently, it takes longer for the adult to learn the nonreversal shift. In contrast the young child responds to each of the values and dimensions as discrete, compartmentalized units and responds to each in a stimulus-response manner and can therefore respond to a nonreversal shift without differentiating that there are two dimensions and that there are different values along those dimensions. The nonmediated process is quicker.

As previously mentioned, a concept is considered to be a mediational process. Conceptual development leads to a more elaborate mediational system.

The phenomenon of reversal/nonreversal shift may be explained in light of this. In the attentional position described by Caron (1969), it is assumed that when relevant stimuli have low attentional value initially, as is likely to occur with younger children, the strength of the attention will be low and suceptible to rapid extinction in the face of more dominant stimuli; hence, rapid nonreversal shifting can occur. The dimensional draw of external cues attains more power over the younger child because he does not have an internal mediational system to counteract the dominant external effect (Caron, 1969). Smiley and Weir (1966) describe the younger child's response tendencies as reflecting an S–R unit, while older children and adults are described as responding more and more in a mediational manner.

Integration of Dimensions. Wilkening (1979) studied information integration of children and adults in judgments of the areas of rectangles. The hypothesis tested was that young children would combine stimulus dimensions differently from older children and adults. The task was a conservation task.

Piaget outlines four stages in the development of conservation: (1) the nonconserver centers on one dimension--either length or width, for example; (2) the child begins to focus on the alternate dimension to the exclusion of the first; (3) the child begins to comprehend the recriprocal relationship between the two dimensions; (4) complete understanding of compensation is achieved.

Miller, Grabowski, and Heldmeyer (1973) found nonconservers attend more to length than to width. This is a reflection of unilateral functioning characteristic of early conceptual development. To the nonconserver, length alone defines amount. The author's explanation of this is that length is the more salient of the two dimensions. The externally-derived dominance exerts its strength over the nonconserver who does not have the appropriate mediating concept to view the problem differently.

In Wilkening's study (1979) all subjects were able to differentiate both length and width as relevant dimensions; however, younger children did not have the appropriate rule for combining the two dimensions to derive an accurate value. Younger children added the values of two dimensions whereas older children and adults applied the correct multiplicative rule in their judgment.

D. Implications for Research

Similarities appear to exist between children with impulsive conceptual tempos, as revealed through the literature, and characteristics of early stages of conceptual development outlined by the previously cited theorists. Rigid behavior, being stimulus-bound and diffuse in reaction, tending to seek structure, for example, appear to reflect earlier stage characteristics. It would appear that impulsive children may be less able than reflective children to process a variety of dimensions simultaneously or to "integrate" information as necessary to solve

a conceptual problem. They tend to behave rigidly seeming to be unable to transcend the immediate stimulus–response saliency of dimensions. They appear limited in their ability to integrate information through the efficient use of a conceptual mediator to reduce the immediate, seemingly unrelated dimensions into a meaningful relationship.

E. Research Objective

It appears reasonable to suspect, on the basis of the preceding theories of conceptual development and review of the literature pertaining to impulsivity/reflectivity and dimensional preference, that children who are conceptually impulsive will perform less well than reflective children on tasks that measure level of conceptual development.

Based on similarities which appear to exist between Impulsive children as revealed through the literature (i.e., rigid behavior, being stimulus–bound and diffuse in reaction) and characteristics of early stages of conceptual development (i.e., vague associations based on subjective perceptual salience rather than an objective cognitive process), the intended purpose of the study was to investigate differences in levels of conceptual development which may exist between conceptually impulsive and conceptually reflective children and to further determine if there are dimensional preferences to which impulsive and reflective children respond to more readily.

F. Specific Purposes and Hypotheses

Specific Purpose 1. To investigate the relationship between scores obtained on: (a) conceptual tempo as indexed by the MFFT: (b) dimensional preferences which become apparent on the forced choice Dimensional Preference Test.

The fact that developmental hierarchies of dimensional preferences seem to exist no doubt has direct implications upon concept formation. Where the perceptual salience of an earlier developmental dimension of colour, for example, exerts a dominating force over a child's processing ability, true concept formation is certain to be limited. Suchman, Rosslyn, and Trabasso (1966), Odom and Guzman (1972), Mitler and Harris (1969), Rollins and Castle (1973), Toppino, Lee and Shisko (1979), and Johnson, Warner, and Silleroy (1971) noted these hierarchies and that resistance to irrelevant, earlier appearing dimensional preferences seemed less likely to occur for younger subjects. Younger subjects were prone to responding to dimensions which appeared earlier in the hierarchy.

Hypothesis 1. There exists a significant relationship between conceptual tempo and colour–form (c–f), colour–number (c–n), and form–number (f) combinations. (a) In the colour–form combination, impulsives will tend to choose colour more frequently than reflectives; (b) in the form–number combination, impulsives will choose form more frequently than reflectives, while reflectives

will show a tendency to choose the number dimension; (c) in general, impulsives will tend to show preference toward colour and form and reflectives will show preference toward form and number.

Specific Purpose 2. To investigate the relationship between scores obtained on two measures of conceptual behavior: (a) conceptual tempo as indexed by the Matching Familiar Figures Test (MFFT); (b) ability to solve a conceptual grouping task as indexed by the Vygotsky Concept Formation Test.

In the review of the literature on conceptual tempo, several characteristics prevalent for impulsive subjects reflect earlier stages of development as outlined in Vygotsky's theory of concept formation. Block and Peterson (1955) describe impulsives as having little tolerance for complexities, tending to exhibit rigid behavior, tending to be stimulus-bound and diffuse in reaction. Impulsives also seem structure-seeking (Block, Block and Harrington, 1974) and will reach closure prematurely on a conceptual task (Mitchell and Ault, 1979). These characteristics seem suggestive of Vygotsky's Phase II, Thinking in Complexes in that subjective impressions as preludes to true concept formation noted by Vygotsky might reasonably be paralled with the stimulus-bound, rigid, premature-closure and structure-seeking characteristics appearing in the literature on conceptual tempo. Clearly, the vague, unstable bonds of Vygotsky's diffuse complex stage bears a strong similarity to Block and Peterson's (1955) description of impulsives as being diffuse in reaction.

Hypothesis 2. There exists a significant relationship between conceptual tempo and performance on Vygotsky's conceptual grouping task. Impulsive subjects, compared with reflectives will: (a) tend to make fewer correct moves; (b) require a larger number of clues to reach a solution; (c) will revert more frequently to previous incorrect moves for which clues have already been given; (d) will tend to use uncommon systems for solving the problem more frequently than reflectives; (e) will tend to score lower when uncommon systems employed are subtracted from common systems employed; (f) and, finally, impulsives will use multiple systems less frequently than reflectives seeming limited in their capacity to consider more than a single dimension at a time toward task solution.

Specific Purpose 3. To investigate the relationship between scores obtained on: (a) conceptual tempo as indexed by the MFFT; (b) level of concept formation as measured by Klausmeier's Conceptual Learning and Development Assessment, Series IV: Tree.

Again, the literature on conceptual tempo reveals characteristics as previously mentioned under Specific Purpose 2 which appears to reflect earlier stages of development under Klausmeier's theory of conceptual learning and development.

Hypothesis 3. There exists a significant relationship between conceptual tempo and performance on Klausmeier's Conceptual Learning and Development

Assessment, Series IV: Tree. Impulsive subjects, compared with reflective subjects will have significantly lower scores on each of the three booklets, B, C, and D, indicating a significantly lower overall level of conceptual development. Further, impulsives will score significantly lower on grouped items of the test which assess: (a) classificatory level functioning; (b) understanding of taxonomic relations; (c) problem-solving skills; (d) understanding principles; (e) discriminating attributes; (f) evaluating examples and nonexamples; (g) understanding vocabulary relevant to the concept.

IV. Research Design and Methodology

In the following chapter, the characteristics of the subjects of the study, the instruments used to assess the children, procedures employed for the study, and statistical methods are discussed.

A. Subjects

The subjects consisted of ninety fourth grade students and were derived from four elementary schools chosen by the Edmonton Public School Board as representing typical Edmonton Public School system schools. Initially, there were fifty-nine females and thirty-one males ranging in age from nine years, two months to eleven years of age. Criteria for inclusion in the study originally were simply that the children be in grade four, and without significant language barriers such as might occur with new immigrants (this consideration was screened informally with teachers), and that recent I.Q. data was already on file for students participating in the study.

Three factors resulted in a decline of the original sample of ninety subjects to the final sample of sixty subjects. Two of these factors constitute limitations of the study, while the third factor formed part of the study procedure.

The first factor resulting in the exclusion of thirteen subjects from the original ninety was that subsequent to doing preliminary testing, it was

discovered that I.Q. information was not on file for these children either because they had recently arrived at the school or were absent on the day I.Q. testing was conducted. For the purposes of time constraints and to keep within reasonable limits the time spent pulling children from class time, it was decided to eliminate these subjects from further study rather than administer the I.Q. test to them.

The second factor was that one subject who was available during preliminary testing moved before final testing took place; consequently, she was necessarily eliminated from the study.

The third factor which forms part of the study procedures involved the further elimination of sixteen subjects from the study. These subjects were excluded from final analysis because they did not meet the criteria necessary for group classification based on the Matching Familiar Figures Test to be described later in this chapter.

The final study group consisted of sixty subjects, forty-one of whom were females and nineteen of whom were males. Ages ranged from nine years, two months to ten years, eleven months for the entire group of sixty subjects. Further, I.Q. information was available for each subject from the outset of the study having been previously administered to the children by the schools involved in the study. The Canadian Cognitive Abilities Test yielded the following results for the study group: verbal I.Q. scores ranged from 73 to 147, with a

mean I.Q. of 110; quantitative I.Q. scores ranged from 74 to 130, with a mean I.Q. of 103; nonverbal I.Q. scores ranged from 71 to 137, with a mean I.Q. of 103.

Table 2 presents a summary of the study group outlining the ranges and means for age, broken down by sex, and for I.Q. information broken down by verbal, quantitative, and nonverbal I.Q. scores.

Insert Table 2 Here

B. Instruments

Matching Familiar Figures Test (MFFT). The MFFT, developed by Kagan (1964) is a visual recognition task designed to provide an index of the subjects position along a dimension between fast-inaccurate (impulsive) and slow-accurate (reflective). In this test the subject is presented with a single familiar picture (the standard) and then asked to select one from among six similar alternatives which is exactly like the standard. A sample item from the MFFT is included in Appendix A. Measures of both response time and error rate are used in determining impulsivity/reflectivity. A sample of the scoring sheet used for the MFFT is included as Appendix B.

Vygotsky Concept Formation Test The Vygotsky Concept Formation Test consists of twenty-two blocks varying in colour, shape, thickness, and area of cross-section (size). It is a conceptual problem which requires that the blocks

TABLE 2

Subject Age Ranges and I.Q. Scores

	N.	Range of Ages	Mean
Age	60	9-2 to 10-11	9-6
- female	41	9-2 to 10-6	9-5
- male	19	9-2 to 10-11	9-7
Verbal I.Q.	60	73-147	110
Quant. I.Q.	60	74-130	103
Nonverbal I.Q.	60	71-131	103

be placed into four different groups on the basis of unifying characteristics which united each member within each group. The blocks are in five different colours (red, blue, yellow, green, white); six shapes (triangle, square, trapezium, hexagon, circle, and semicircle); two thicknesses (a ratio of approximately 2:1); and two sizes (a ratio of approximately 2:1). The two criteria of thickness and size must be combined to arrive at a correct solution to the problem. Thus, there will be a group comprised of small thick blocks, one of small, thin blocks, one of large, thick blocks, and one of large, thin blocks. The subject must divide the blocks into the four groups, but must also be able to provide the rationale for his choice.

The Penny (1951) method of administration was employed for the Vygotsky Test as it provides a more systematic, standardized approach than other methods (Hanfman and Kasanin, 1937; Semeonoff and Laird, 1952 Semeonoff and Trist, 1958).

Using the Penny system of scoring, data on six different variables were obtained:

(1) the number of correct moves, based upon using both height and width, or height and surface area as relevant dimensions for the problem-solving (denoted "CM");

(2) the number of clues given by the examiner each time an error was made by the subject (denoted "clues");

(3) the number of repetitions of moves based on incorrect dimensions for which a clue had already been given--reversions to an incorrect dimension or system of more than one dimension (denoted "REV");

(4) the number of common and uncommon systems employed were: (a) common systems refer to grouping based on frequently used dimensions such as height (denoted "H"), width (denoted "W"), surface area (denoted "SA"), form (denoted "F"), colour (denoted "C"), and volume (denoted "V"), and,

(b) uncommon systems refer to grouping based on less commonly used criteria such as poor forms (denoted "f") (i.e., grouping a triangle with a trapezoid), a mixture of dimensions within each group (denoted "M") (i.e., one of each colour or one of each shape within the group), equality (denoted "E") (i.e., each group must have a triangle and a trapezoid, each group must have the same number of blocks in it, each group must have an even distribution of colours), a guess (denoted "?"), using the blocks to make something such as a tower or to construct a puzzle-like picture (denoted "P").

(5) the total difference between the number of common sytstems minus the number of uncommon systems employed;

(6) the frequency with which multiple systems were used (i.e., using more than one dimension simultaneously) compared to single systems (i.e., attempting to justify a move based on a single dimension).

The Penny method of administration appears in Appendix C, a sample record sheet in Appendix D, and the Vygotsky Tabulation Sheet appears in Appendix E.

Dimensional Preference Test. This test is designed to elicit responses to a preferred dimensions when subjects are confronted with a bidimensional choice. The materials consist of four inch by five inch cards. Three different dimensions--colour, form, and number--are represented on the cards in three different combinations of two--colour-form, colour-number, form-number--by various geometrical shapes of various colours being affixed to the cards. A sample item appears in Appendix F. Three cards are placed in front of the subject and the subject is asked to choose two of the cards from the three which are the same based on his preference. In each of fifteen trials (five trials each for the colour-form, colour-number, and form-number combinations) there are two different possible dimensions upon which the choice can be made. Responses to each preferred dimension identified by each subject are totalled. A sample of the scoring sheet used for the task appears in Appendix G.

Klausmeier's Conceptual Learning and Development Assessment, Series IV: Tree. Klausmeier's test was developed for the purpose of assessing the level of concept formation a child has achieved. It is a group administered, paper and pencil, multiple choice task. For the purposes of the present study,

booklets B, C, and D of Series IV: Tree were administered. Booklet B primarily assesses classificatory level criteria as well as whether or not the child understands taxonomic relations; Booklet C is designed to assess problem-solving skills and understanding principles; Booklet D assesses the child's ability to discriminate attributes, to evaluate examples and nonexamples of class as well as vocabulary associated with the concept of tree. Sample items from Booklets B, C, and D appear in Appendix H.

Canadian Cognitive Abilities Test. The Canadian Cognitive Abilities Test evolved from the Lorge-Thorndike Intelligence Test Series. It is a group administered I.Q. test which provides measures of three separate abilities focusing on the individual's ability to manipulate abstract and symbolic relationships. Relational thinking as well as flexibility of thought are emphasized. The verbal I.Q. is composed of vocabulary, sentence completion, verbal classification, and verbal analogies; the quantitative I.Q. is composed of quantitative relations, number series, and equation building; the nonverbal I.Q. is composed of figure analogies, figure classification, and figure synthesis.

C. Research Design

The purpose of the study was to investigate differences in levels of conceptual development which may exist between conceptually impulsive and conceptually reflective individuals, and to further determine if there are

differences in dimensional preferences to which members of each group respond more readily.

Testing was conducted on three separate occasions. The Matching Familiar Figures Test (MFFT) and Dimensional Preference Test were the first tests to be administered to all subjects. The MFFT served as an independent variable in that two groups were delineated on the basis of results of the MFFT: an impulsive group and a reflective group. Criteria for group membership were number of errors and latency period with impulsives having greater than the mean error rate and less than the mean latency period, and reflectives having fewer than the mean error rate and greater than the mean latency period. As previously mentioned, sixteen of the original sample of ninety subjects were eliminated from the study on the basis of the MFFT procedures. This was due to the fact that either their error rate or response time fell exactly on the group mean score.

Approximately two weeks after the first individual testing session the Klausmeier, Conceptual Learning and Development Assessment was administered to groups of children that formed the final study group. Testing took place at each of the four schools. The entire battery of three booklets was read to students while students worked only on the question being read by the test administrator. Students marked their answers directly on the test booklets provided.

The final test to be administered was the Vygotsky Concept Formation Test which, again, was individually administered in accordance with procedures as outlined in Appendix C.

D. Statistical Method

Initially, Pearson Product-Moment correlations were used to determine if correlations existed between age, intelligence, and the conceptual development process. Correlations of age and the three I.Q. scores to all of the Klausmeier and Vygotsky test measures were determined.

The hypotheses presented in this study were tested by means of t-tests to ascertain if significant differences between the impulsive and reflective groups existed on dimensional preference tasks, as well as on Klausmeier and Vygotsky's concept formation tests. It is recognized that t-tests on this many variables has limitations. Stepwise regression with cross validation was also used as a means to assess which of the variables acquired the greatest power in defining group (impulsivity/reflectivity) membership.

V. Results

In the following chapter, results from the statistical analysis of data are presented. Pearson Product-moment correlations between various conceptual level measures to age and I.Q. are reported, the purpose of which is to determine whether or not age and/or I.Q. bear a particular relationship to the process of conceptual development. Secondly, with the sample divided into two groups--impulsive and reflective--t-tests were conducted on each of the variables to ascertain if there were significant differences between impulsive and reflective children with respect to their performance on certain aspects of concept formation. Thirdly, stepwise regression with cross validation was employed to determine which variables were the best predictors of group membership. The probability level for accepting or rejecting an hypothesis was at .05.

A. Correlational Data

Tables 3 (a) and (b) contain results from Pearson Product-moment correlations which were calculated to examine the relationship between age and conceptual level as well as verbal, quantitative, and nonverbal I.Q.'s to conceptual level. Booklets B, C, and D from the Klausmeier conceputal levels task and the seven variables from the Vygotsky Concept Formation Test were each correlated with age and I.Q. As previously mentioned, Booklet B of the Klausmeier task

focuses on assessing classificatory level criteria and understanding taxonomic relations, Booklet C on problem-solving and understanding principles, and Booklet D on discriminating attributes, evaluating examples and nonexamples of class, and vocabulary associated with the concept of tree. From the Vygotsky Concept Formation Task, the following variables were correlated to both age and I.Q.: number of correct moves, number of clues given, number of reversions, number of common systems used, number of uncommon systems used, common systems minus uncommon systems used, multiple versus single systems used.

Insert Table 3 (a) Here

Klausmeier CLD Assessment. When correlations were computed between the Klausmeier tasks--(Booklets B, C, and D) and age as well as I.Q., some statistically significant relationships were found. None of the correlations of age to the Klausmeier tasks reached significant levels; however, some significant correlations between I.Q. measures and performance on the Klausmeier tasks were found. Positive correlations between verbal, quantitative, and nonverbal I.Q.'s to Booklets C and D were significant, suggesting that as I.Q. increases performance in problem-solving, understanding principles, discriminating attributes, evaluating examples and nonexamples, and relevant vocabulary, as measured by the Klausmeier task, similarly increases. Interestingly, no significant relationship between verbal, quantitative, and nonverbal I.Q. to Booklet B of Klausmeier's task (classificatory level, understanding taxonomic relationships) was found.

TABLE 3 (a)

Pearson Product Moment Correlations:
Age and I.Q. to Klausmeier Conceptual Learning and
Development Assessment, Series IV: Tree - Booklets B,C,D

	Klausmeier Booklet B	Klausmeier Booklet C	Klausmeier Booklet D
Age	.1158	-.0325	-.0841
Verbal I.Q.	-.0144	.3169*	.4701*
Quantitative I.Q.	.1077	.3196*	.4955*
Nonverbal I.Q.	.0312	.2909*	.3698*

*Significant at the .05 level

Insert Table 3 (b)

Vygotsky Concept Formation Task. Within the Vygotsky Concept Formation measures a similar pattern was evident in that age was not significantly correlated with the Vygotsky measures, and there were some significant correlations between I.Q. and the Vygotsky measures. Verbal, quantitative, and nonverbal I.Q. were significantly correlated in a positive direction to three of the Vygotsky variables.

There was a positive correlation between the three I.Q.'s and the number of correct moves made in solving the task indicating that as I.Q. increases, there is a concomitant tendency to be able to make more correct moves in solving the Vygotsky Concept Formation Test.

Secondly, there was also a positive correlation found between I.Q. and the difference between the number of common systems employed to solve the task minus the number of uncommon systems employed. In essence, this suggests that as I.Q. increases the tendency to focus on common systems of conceptual grouping such as height, width, and colour also increases, and there is less propensity to resort to uncommon systems such as in trying to group on the basis of vague attributes (i.e., poor forms--triangle with trapezoid).

A third positive correlation was found between I.Q. and the number of multiple systems used minus the number of single systems used to work towards task solution. That is, each time the child grouped on the basis of two

TABLE 3 (b)

Pearson Product Moment Correlations:
Age and I.Q. to Vygotsky Concept Formation Task

	Correct Moves	Clues	Reversions	Common Systems	Un-Common Systems	C-U Difference	Mult. vs Single System
Age	-.1829	.0954	.0612	.0785	.1765	-.1005	-.1219
Verbal I.Q.	.5340*	-.3441*	-.4168*	.0434	-.3717*	.3323*	.4572*
Quant. I.Q.	.4479*	-.2249*	-.2760*	.0307	-.4385*	.3801*	.4363*
Non-Verbal I.Q.	.4483*	-.2294*	-.3137*	.1501	-.3568*	.3816*	.4254*

*Significant at the .05 level

criteria simultaneously such as placing a block in a group because it was both the same height and width of other members in the group, he was considered to have employed a multiple system; alternatively, if his rationale for grouping included reference to a single dimension such as height only, he was considered to have employed only a single system. The positive correlation found between I.Q. and multiple minus single system approaches suggests that as I.Q. increases there is a concomitant increase in the number of multiple over single systems used in task solution.

Verbal, quantitative, and nonverbal I.Q. were also significantly correlated to three other Vygotsky variables, but this time in a negative direction. A significant negative correlation existed between the number of clues given to the subject by the examiner and I.Q. scores. As I.Q. decreased a greater number of clues were necessarily given to facilitate task completion.

The second significant negative correlation occurred between I.Q. and the total number of reversions to incorrect systems for solution. As previously mentioned, each time an incorrect move or explanation for the move was made, the subject was given a clue indicating his conceptual strategy was in error in some way. If the subject then reverted back to that same system for which a clue indicating error had already been given, he was considered to have made a "reversion." The negative correlation between I.Q. and the number of reversions made by the subject suggests as I.Q. increases subjects were less inclined to

be bound to a limited number of fixed systems, but were able to profit from the feedback and to consider and test a wider variety of systems.

The third negative correlation which reached significance was between I.Q. and the number of uncommon systems used. The correlation indicates that as I.Q. increases, the use of uncommon systems decreased. Interestingly, the correlation between I.Q. and the number of common systems employed was not significant. It seems apparent that regardless of I.Q., all children did focus on common systems, and I.Q. did not seem to bear much relationship to utilizing common system strategies. The negative correlation between I.Q. and uncommon systems, however, implies that children whose I.Q. scores were lower tended also to resort significantly more often to vague, uncommon systems for task solution.

B. T-Tests

Tables 4 (a), (b), (c), and (d) contain results from t-tests which were carried out for all variables to determine if significant differences exist between the impulsive and reflective groups with respect to each of these variables. Again, the level of significance was at the .05 level. Table 4 (a) summarizes results from the Dimensional Preference task where subjects were given a forced choice task, necessitating a choice between: (1) colour and form; (2) colour and number; (3) form and number. Results of the t-tests are as follows.

Insert Table 4 (a) Here

Dimensional Preference Test. Two of the six possible dimensions of choice yielded significant results between the reflective and impulsive groups. There were no significant differences between reflective and impulsives on either the colour-form or colour-number bidimensional choice tasks. Both groups responded in a similar manner to these dimensional choices. However, when form and number were paired together, conceptually impulsive children indicated significantly more form than number choices while reflective children indicated a preference for the number dimension over the form dimension significantly more frequently.

Canadian Cognitive Abilities Test. As previously noted, the present results demonstrate significant correlations between I.Q. and several of the conceptual levels measures. Going a step further, there also appears to be a significant specific relationship between I.Q. and group membership of either impulsivity or reflectivity as is apparent in Table 4 (b).

Insert Table 4 (b) Here

Differences between the impulsive and reflective groups are significant for all three I.Q. measures: verbal, quantitative and nonverval. Conceptually impulsive children's I.Q. scores tended to be significantly lower than those of conceptually reflective children.

TABLE 4 (a)

T-tests: Dimensional Preference Task

Variable	T Value	df	2-tail prob.
Colour	.00	58	1.000
Form	.00	58	1.000
Colour	.38	58	.703
Number	-.38	58	.703
Form	2.55	58	.014*
Number	-2.55	58	.014*

*Significant at the .05 level

TABLE 4 (b)

T-tests: Verbal, Quantitative, Nonverbal I.Q. Scores
(Canadian Cognitive Abilities Test)

Variable	T Value	df	2-tail Prob.
Verbal I.Q.	-2.22	58	.031*
Quant. I.Q.	-2.90	58	.005*
Nonverb. I.Q.	-2.50	58	.015*

*Significant at the .05 level

Klausmeier CLD Assessment. For the Klausmeier CLD Assessment, t-tests were conducted on each of the three booklets (B, C, and D) as well as on the specific subsections of each booklet depicting a subskill of conceptual development. Results are presented in Table 4 (c) following.

Insert Table 4 (c) Here

For the Klausmeier assessment, a mixture of significant and nonsignificant differences are apparent. No significant differences between reflective and impulsive children were evident for booklet B which comprised classificatory level skills and understanding taxonomic relationships. Both groups performed equally well on this task.

Significant differences were apparent between impulsives and reflectives, however, on all parts of booklet C which is comprised of problem-solving skills and understanding principles. Booklet C, of the three Klausmeier booklets used in the study afforded the greatest discriminability between impulsives and reflectives in that significant differences were evident for each subpart of the booklet. Impulsives performed consistently and significantly less well than reflectives in problem-solving and in demonstrating their understanding of principles relevant to the concept of tree.

In booklet D, significant differences between impulsive and reflective children were again apparent, but seemed more restricted. While discriminating attributes, relevant vocabulary to the concept of tree, and evaluating examples

TABLE 4 (c)

T-tests: Klausmeier's Conceptual Learning and Development Assessment, Series IV: Tree

Variable	T Value	df	2-Tail Prob.
Booklet B	-.75	58	.456
Classif. Level	1.04	58	.304
Taxonomic Relations	-.25	58	.800
Booklet C	-4.40	46.59	.00*
Problem-Solving	3.95	47.84	.00*
Understanding Principles	3.33	58	.002*
Booklet C	-3.32	58	.002*
Discriminating Attributes	-1.17	58	.248
Vocabulary	2.05	58	.045
Evaluating Examples and Nonexamples	3.44	58	.001*

*Significant at the .05 level

and nonexamples of the concept of tree are identified as subskills of the booklet, only the latter, evaluating examples and nonexamples, reached significance. In effect, there were no differences between impulsives and reflectives with respect to their abilities to both accurately discriminate relevant attributes of the concept of tree and to identify the relevant vocabulary. The one area of significant difference was that reflectives were significantly better able to accurately evaluate examples and nonexamples related to the concept of tree.

Vygotsky Concept Formation Test. The final series of t-tests were applied to variables related to the Vygotsky Concept Formation Test. Results are as follows.

Insert Table 4 (d) Here

Significant differences between impulsive and reflective children appear for five out of the seven variables tested. Results indicate that reflective children made significantly more correct moves toward task solution than their impulsive counterparts, needed significantly fewer clues, and tended to revert significantly less frequently to previously identified incorrect strategies. Reflectives also were significantly less inclined to resort to "uncommon" systems and were significantly more inclined to try more than one dimensions at a time in their efforts to reach the solution.

TABLE 4 (d)

T-tests: Vygotsky Concept Formation Test

Variable	T Value	df	2-Tail Prob.
Correct Moves	-5.70	58	.00*
Clues	4.15	58	.00*
Reversions	3.11	58	.003*
Common Systems	.75	58	.458
Uncommon Systems	1.89	58	.005*
Common minus Uncommon Systems	-1.86	58	.068
Multiple Minus Single System	-5.17	58	.000*

*Significant at the .05 level

A similar pattern appears for the t-test data as was noted in the correlational data where I.Q. level seemed to bear no correlation to the utilization of common systems in working toward a solution to the Vygotsky block test. The correlation between I.Q. and the propensity to employ common systems was not significant. Similarly, no significant difference was found in the extent to which impulsives and reflectives employed common systems to reach task solution. Although impulsives employed significantly more uncommon systems as part of their strategy, the fact that there was no significant difference between the two groups for common minus uncommon systems used suggests a significant reliance on common systems for both groups.

C. Stepwise Regression with Cross Validation

Stepwise regression was used as a means of determining which variables were the best predictors of impulsivity and reflectivity. In Table 5 (a), I.Q. measures and total scores for Klausmeier booklets B, C, and D were included in the stepwise regression analysis; Table 5 (b) includes only variables related to the Klausmeier tasks; Table 5 (c) includes only variables related to the Vygotsky Concept Fromation Test; and Table 5 (d) includes virtually all variables: sex, Dimensional Preference Test, I.Q., all of the Klausmeier variables and all of the variables from the Vygotsky Concept Formation Test.

In the first table, 5 (a), where I.Q. and totals from the Klausmeier test booklets B, C, and D were analyzed with stepwise regression, only two variables reached significant levels. Booklets C (problem-solving skills and understanding principles) and D (discriminating attributes, relevant vocabulary to the concept of tree, and evaluating examples and nonexamples) were identified as being the best predictors of group membership with multiple correlations of .500 and .548 respectively. None of the I.Q. measures attained significant levels, nor did booklet B (classificatory level skills and understanding taxonomic relationships) of the Klausmeier test.

Insert Table 5 (a) Here

The correlation between booklets C and D is .20. This is low enough to suggest that B more likely appears as the last variable in the analysis by virtue of its limited power to discriminate between the two groups of impulsive and reflective subjects rather than by virtue of having a strong correlation with C and having been knocked to the bottom as a consequence of that high correlation.

In summary, while differences in I.Q. between impulsive and reflective children did reach significant levels in the present study when compared using the Klausmeier Conceptual Levels Test, I.Q. was not a good predictor of impulsivity/reflectivity. Booklets C and D came out as being good predictors of group membership.

TABLE 5 (a)

Stepwise Regression with Cross Validation
Verbal, Quantitative, Nonverbal I.Q. and
Klausmeier Booklets, B, C, and D

Variable	Multiple Correlation	2-tail Prob.
Klausmeier Booklet C	.500	.001*
Booklet D	.548	.022*
Quantitative I.Q.	.562	.303
Nonverbal I.Q.	.564	.938
Verbal I.Q.	.566	.959

*Significant at the .05 level

Since some of the Klausmeier CLD booklets came out as good predictors, further analysis was undertaken by including composite scores of each of the three booklets as well as a breakdown of scores from within booklets. Stepwise regression for these variables appears in Table 5 (b) and gives an indication of which of the subskills of this test best define impulsivity/reflectivity.

Insert Table 5 (b) Here

Four of the ten variables included in this part of the stepwise regression analysis reached significant levels. Again, booklet C appeared to provide the greatest discriminability. The composite score for booklet C as well as scores from both of the subsections, problem-solving skills and understanding principles, were significant. However, while booklet D had come out as being a significant predictor of group membership, when subsections of the booklet were included in the analysis, only the ability to evaluate examples and nonexamples reached significance. Booklet D as a whole was not a good predictor seemingly because discriminating attributes as well as knowledge of relevant vocabulary did not differ significantly enough between the two groups.

Within the Vygotsky measures appearing in Table 5 (c), two of the five measures included in the stepwise regression reached a significant level as predictors of group membership: the number of correct moves made in solving the problem as well as the number of reversions back to previously tried,

TABLE 5 (b)

Stepwise Regression with Cross Validation
Klausmeier Conceptual Learning and Development
Assessment

Variable	Multiple Correlation	2-tail Prob.
Klausmeier Booklet C	.500	.001*
Evaluating Examples and Nonexamples	.583	.001*
Problem-Solving	.610	.045*
Understanding Principles	.638	.017*
Klausmeier Booklet D	.651	.184
Discriminating Attributes	.657	.621
Klausmeier Booklet B	.659	.988
Taxonomic Relations	.659	1.000
Vocabulary	.659	1.000
Classificatory Level	.659	1.000

*Significant at the .05 level

incorrect moves, with multiple correlations of .60 and .63 respectively. However, while number of clues given and the number of multiple systems minus the number of single systems used do not reach significant levels, both of these variables have fairly high correlations with correct moves and reversions suggesting that the number of clues given and the tendency to employ a greater number of multiple systems also bear a reasonably strong relationship to impulsivity/reflectivity. The correlation of correct moves made with multiple minus single systems used is .87; the correlation between the number of correct moves made and the number of clues given is −.71. It is possible that these two variables (clues given and multiple minus single system) are also good predictors of group membership, but were shifted down in the analysis due to their strong correlations with variables which did come out as being significant.

Insert Table 5 (c) Here

In the final analysis using stepwise regression, all variables–sex, dimensional preference, I.Q. and the two conceptual levels tests (Klausmeier CLD Assessment and the Vygotsky Concept Formation Test)––were included. Since "shrinkage" tends to occur (Ferguson, 1976) partially as a function of increases in the number of predictors, it makes sense when doing an analysis with this many variables to only consider variables ranking highest rather than all variables which reach significance. Table 5 (d) following contains results from this analysis.

Insert Table 5 (d) Here

TABLE 5 (c)

Stepwise Regression with Cross Validation
Vygotsky Concept Formation Test

Variable	Multiple Correlation	2-tail Prob.
Correct Moves	.600	.001*
Reversions	.631	.032*
Clues	.640	.357
Common Minus Uncommon Systems	.651	.993
Multiple minus Single Systems	.651	.993
Common Systems	.651	1.000
Uncommon Systems	.651	1.000

*Significant at the .05 level

TABLE 5 (d)

Stepwise Regression with Cross Validation
Sex, Dimensional Preference Test, I.Q.,
Klausmeier CLD Assessment, Vygotsky Concept
Formation Test

Variable	Multiple Correlation	2-tail Prob.
Vyg. - Correct Moves	.600	.001*
Klaus. - prob. solving	.679	.001*
Dimen. Pref. (nbr)	.713	.002*
Vyg. - Reversions	.738	.004*
Klaus. - discriminating Attributes	.758	.006*
Klaus. - Booklet D	.772	.015*
Vyg. - Uncommon Sys.	.785	.023*
Sex	.793	.085
Klaus. - Evaluating Examples & Nonexamp.	.800	.217
Klaus. - understanding Principles	.805	.289
Klaus. - Booklet B	.808	.781
Verbal I.Q.	.812	.641
Quant. I.Q.	.817	.330
Vyg. - Clues	.818	.993
Klaus. - vocabulary	.819	1.000
Klaus. - classif.	.819	1.000
Vyg. - Mult/Single	.819	1.000
Klaus. - Taxonomic Rel.	.819	1.000
Klaus. - Common/Uncomm.	.819	1.000
Dimensional Pref (form)	.819	1.000

*Significant at the .05 level

Correct moves made on the Vygotsky test, the problem-solving part of booklet C on the Klausmeier test and a preference for the number dimension on the Dimensional Preference Test attained significant probabilities with multiple correlations of .60, .68, and .71 respectively. These results are consistent with previously reported results where tests were individually subjected to the same statistical analysis. The Dimensional Preference Test had not previously been included, however.

Results of the study confirm the three stated hypotheses to a certain extent. For the Dimension Preference Test significant findings were apparent for only the last condition of the task, namely when form and number were paired. Impulsives chose form significantly more frequently, while reflectives chose number significantly more frequently. No significant differences were found from colour-form or colour-number combinations. The second hypothesis regarding the Vygotsky Concept Formation Test similarly resulted in some mixed findings. The number of correct moves made by reflective subjects were signficantly greater than those of impulsive subjects, while impulsive subjects made significantly more reversions to incorrect strategies and there was also some support indicatiing that impulsives tend to use uncommon strategies reflecting an earlier stage of conceptual development. For the Klausmeier task, relating to the third hypothesis stated, again, reflective children demonstrated higher levels of conceptual skill in that they achieved significantly better performance in

understanding principles, in problem-solving skills and in evaluating examples and nonexamples. No significant differences were apparent other skills assessed by the test such as discriminating attributes, taxonomic relations, relevant vocabulary pertaining to the concept of tree.

VI. Discussion and Conclusions

In a global sense, the researcher has hypothesized that there is a relationship between conceptual tempo and level of conceptual development, and that children identified by the Matching Familiar Figures Test as having a reflective conceptual tempo would be significantly more inclined to perform at higher levels on conceptual levels tasks. Measures that were used include the Matching Familiar Figures Test to delineate impulsive and reflective subjects, the Canadian Cognitive Abilities Test as a measure of I.Q., a Dimensional Preference Test used to assess an aspect of perceptual inclination, and two tests which assess level of conceptual development, the Vygotsky Concept Formation Test and Klausmeier's Conceptual Learning and Development Assessment. Specific hypotheses were: (1) that reflective children, when given a choice to choose from between two dimensions where there was no right or wrong answer, would be inclined to select the developmentally more advanced dimensions (i.e., when colour and form are paired, reflectives would choose more form responses, when colour and number are paired, reflectives would choose more number responses, when form and number are paired reflectives would choose more number responses compared to impulsive subjects; (2) that reflective children would perform better on the Vygotsky Concept Formation Test as compared to impulsive children; (3) that reflective children would perform better on the Klausmeier Conceptual Learning and Development Assessment than

impulsive children.

A discussion of the differential performance of conceptually impulsive and conceptually reflective children on each of these tasks follows relating that performance back to findings reported through the literature as well as to characteristics of conceptual stage of development as hypothesized by Klausmeier and Vygotsky. The chapter begins with a discussion of I.Q. differences between impulsive and reflective subjects which were reported in the previous chapter. Significant differences regarding the dimensional preference task, the Klausmeier Conceptual Learning and Development Test, and finally the Vygotsky Concept Formation test are then discussed. The final part of the chapter is a summary and synthesis of results.

Conceptual Level and I.Q. Tables 3 (a) and 3 (b) illustrate a significant correlation correlation between I.Q. and performance on both conceptual levels tasks. All three I.Q. measures--verbal, quantitative and nonverbal--are significantly correlated to both the Klausmeier and Vygotsky tasks. In view of the fact that Kagan developed the Matching Familiar Figures Test as a means of explaining differences which were not attributable to differences in I.Q., the present significant correlations between I.Q. and conceptual levels tasks might be unexpected since there does seem to be a significant relationship between the conceptual levels tasks and a tendency to be impulsive or reflective as defined by the Matching Familiar Figures Test. However, the nature of the Canadian

Cognitive Abilities Test is such that it emphasizes "relational" thinking and subsections of each of the verbal, quantitative, and nonverbal parts of the test focus, for example, on verbal classification, quantitative relations, and figure classification. The test places a strong emphasis on conceptual skills as a measure of intelligence.

Impulsivity/Reflectivity and the Dimensional Preference Test. The results presented in Table 4 (a) also indicate that when given a choice between two different dimensions as, for example, when the dimension of form and the dimension of number are both correct alternatives and the subject is asked to choose between the two on the basis of preference, impulsive children made significantly more form choices, while reflective children made significantly more number dimension choices. The literature previously cited reports that a hierarchy of preferences emerges for children with a decrease in preference for colour and an increase in preference for number with age (Mitler and Harris, 1969; Rosslyn and Trabasso, 1966; Odom and Guzman, 1972). While no significant differences in age were apparent between the impulsive and reflective groups in the present study, this same preference for the number dimension was apparent for reflective subjects, but not impulsive subjects.

Concept formation clearly has perception as one of its prerequisites and the notion of dimensional preference would seem to emphasize this perception. Researchers of dimensional preference make reference to the perceptual salience

of dimensions within a young child's environment as creating a bias which dominates the child's learning style. Young children have difficulty inhibiting responding to these dominant perceptual cues and tend to solve conceptual problems on the basis of a single preferred dimension (Johnson, Warner, and Silleroy, 1971). In addition, younger children perform better on conceptual tasks when there is congruence between their preferred dimension and the task-relevant dimension (Suchman and Trabasso, 1966; Rollins and Castle, 1973; Toppino, Lee, and Shisko, 1979).

Going back to the reversal/nonreversal shift performance and the finding that colour-preferring subjects tended to make nonreversal shifts quicker (hypothesized as an S-R strategy) and that form-preferring subjects tended to make reversal shifts quicker (hypothesized as a conceptually mediated strategy), it appears that children who respond to dimensions which occur later developmentally also demonstrate a reversal shift strategy which implies conceptual mediation.

It does appear that there are some similarities between the response tendencies on a dimensional preference task of younger children as reported in the literature and conceptually impulsive children in the present study. Both respond consistently to dimensions which seem to reflect earlier developmental stages. Recognizing that it would be taking a quantum leap to suggest that all of the foregoing regarding the perceptual response tendencies of young children

apply to conceptually impulsive children, it would appear plausible that some of the perceptual strategies employed by the young child in attempting to solve a conceptual problem are perhaps preserved and employed by the conceptually impulsive child.

Impulsivity/Reflectivity and the Klausmeier Conceptual Learning and Development Assessment. Relating back to Klausmeier's theory of conceptual development, the four levels of concept attainment were dependent upon a number of mental operations. At all four levels, three specific operations are ongoing: the ability to attend to the stimuli, the ability to discriminate perceptible features of the stimuli, and the ability to remember those features. Beyond the first two levels of conceptual attainment (concrete level and identity level), two more operations are added to these three: the ability to generalize beyond a given example to one or more examples displayed with several nonexamples, the ability to hypothesize, and to evaluate in order to solve problems. Klausmeier's test is constructed such that as the test progresses through each sub-part, the requirements for these mental operations becomes more difficult. The need to attend becomes more involved, for example, as the number of alternatives from which to choose gradually increases with successive items, and the requirement for discrimination also increases by virtue of having the nonexamples progressively become more like the examples. Remembering necessarily becomes more complex as a result. Successive items also require

generalizing to larger numbers of examples which concomitantly required greater discriminability because both variable and relevant attributes of the concept were increasingly similar.

Recalling the Klausmeier task used in this study, there were three separate booklets called B, C, and D, each of which, while requiring the mental operations of attending, discriminating, remembering, generalizing, hypothesizing, and evaluating,. attempt to measure acquisition of these skills at progressively more conceptually sophisticated levels. In addition, sub-parts of each of the booklets emphasize particular requirements. Booklet B began with items which required an ability to treat two or more instances of the same class of objects as equivalent, and to recognize when an object was included or excluded from the class (taxonomic relations). Booklet C required an ability to comprehend relationships between two or more concepts (understanding principles). Principles, like concepts, are a medium through which experiential or perceptual phenomena can be interpreted. Consequently, principles can be used to predict consequences from known conditions and can facilitate problem-solving skills. Booklet D required a higher level of ability in discriminating attributes, it assessed vocabulary relevant to the concept of tree, and finally, Booklet D assessed the ability to evaluate examples and nonexamples. The process of evaluation necessitates the ability to evaluate examples and nonexamples on the basis of the presence or absence of defining attributes of

the concept. For example, in evaluating the concept of tree as diffeent from shrub or herb, it would be necessary to retrieve from memory the critical attribute of a tree, namely, a woody stem, and to then evaluate shrubs and herbs against that critical attribute.

Significant differences between impulsive and reflective children with respect to their performance on the Klausmeier assessment were apparent in the present study. When t-tests were conducted (Table 4 (c)) comparing the performance of impulsive and reflective subjects, three sub-sections of the Klausmeier test yielded significant differences: reflective children performed significantly better than impulsive children in problem-solving skills, in demonstrating their understanding of the principles, and in evaluating examples and nonexamples of the concept of tree. Results from stepwise regression with cross validation (Table 5 (b)) yielded significant results indicating that Booklet C, including problem solving and understanding principles as well as evaluating examples and nonexamples from Booklet D were the best predictors of group membership suggesting that in performing the Klausmeier task differences between impulsive and reflective children were apparent in these parts of the task in particular. There is congruence between results of t-tests and results of the stepwise regression in terms of which variables come out as being significant. Reflective children performed significantly better compared to impulsive children in demonstrating their capacity to understand principles, to

problem-solve, and to evaluate examples and nonexamples of the concept of tree.

No significant differences between impulsive and reflective subjects were apparent in terms of their respective abilities to demonstrate an understanding of the inclusion or exclusion of examples when fewer attributes were presented and readily perceptual differences could be used to discriminate inclusion or exclusion (taxonomic relations). However, when a sequential, cognitive process was necessarily added as a requirement to determine a correct response such as is required to "evaluate" or to "problem-solve", impulsives performed less well.

In addition, the impulsives were significantly less inclined to be able to demonstrate an understanding of conceptual principles that would facilitate their capacity for evaluation and problem-solving. The present results suggest that impulsive children in the study were demonstrating conceptual characteristics reflecting earlier stages of conceptual development seeming to have more difficulty compared with their reflective classmates with characteristics of later stages of conceptual development as defined in the Klausmeier theory of conceptual levels.

Impulsivity/Reflectivity and the Vygotsky Concept Formation Test. Vygotsky's theory of conceptual development is a progression through three phases beginning with "syncretic" thinking in which unity or associations are

created on the basis of vague, subjective impressions; occurring next is thinking in "complexes" whereby thinking is more objective and is based on factual, perceptible properties; and finally, conceptual thinking occurs in which the organization of factual attributes is tightened and the individual can transcend the immediacy of perceptual experience to abstract only relevant information and conceptually analyze and synthesize beyond the perceptual information. Several stages within each phase are characterized by specific tendencies for organizing information (i.e., groupings based on perceptual similarities of objects).

The Vygotsky Concept Formation Test requires grouping twenty-one blocks into four different groups so that one group is comprised of tall, wide blocks, another group comprised of short, wide blocks, another of tall, narrow blocks, and the last of short, narrow blocks. The blocks are a variety of colours and shapes (five different colours and six different shapes so that colour and shape are irrelevant dimensions to task solution since the blocks must be organized into only four groups). In this test the perceptual salience of both the colour and form of the blocks is readily apparent, but in order to solve the task, the subject must transcend the perceptual salience of these irrelevant dimensions, analyze the visual array and abstract other possible relevant dimensions and to then combine two dimensions cognitively before being able to hypothesize the relevant combinations of dimensions for each group to select appropriate group members or to synthesize each correct group.

Significant differences between impulsive and reflective children, as determined by the t-tests (table 4 (d)), with respect to their performance on the Vygotsky Concept Formation Test were apparent in the present study. Results indicate that reflective children, as compared with impulsive children, made significantly more correct moves in solving the conceptual task, they needed a fewer number of clues to do so, they were less inclined to revert back to incorrect systems and to employ uncommon systems to solve the task and were more adept at recognizing and employing "multiple" systems (i.e., using two dimensions--height and width-simultaneously). When stepwise regression was used on the data for the Vygotsky Concept Formation Test (Table 5 (c)), only two of the variables reached significant levels as predictors of impulsivity and reflectivity, namely the number of correct moves made and the number of reversions to incorrect systems. However, when variables from all conceptual tasks were analyzed using stepwise regression, the number of correct moves, the frequency of reversions to incorrect systems, and the number of uncommon systems employed all reached significant levels as predictors of group membership.

The present results of the Vygotsky Concept Formation Test do indicate differences between impulsive and reflective children in their ability to perform a conceptual task. The fact that reflective subjects made significantly more correct moves implies a capacity to transcend the two salient dimensions of

colour and form, and to abstract and combine the relevant dimensions to accurately synthesize the groups. Impulsive subjects, in contrast, tended to revert back to incorrect systems suggesting an inclination to be rigidly bound by some facet of their strategy which, possibly was to the perceptual salience of the irrelevant dimensions. Impulsive subjects also tended to employ more "uncommon" systems for solving the task. These uncommon systems represent bonds based on earlier stages of concept formation within the Vygotskian theory of stages of development. For example, the Penny System for scoring the test includes several "uncommon" systems such as placing poor forms together (i.e., triangle and trapezoid) stating their likeness. Within the Vygotskian theory of stages of conceptual development, these uncommon systems reflect Phase II, thinking in Complexes where groupings are based on factual bonds, but the associations are still governed to some extent by subjective impressions.

Collectively, results of the present study do indicate differences between impulsive and reflective children in their level of conceptual development. In the present study reflective children had significantly higher I.Q.'s compared to impulsive children, although the I.Q. test used is highly conceptually oriented. Impulsive children demonstrated perceptual response tendencies on the Dimensional Preference Test which bear similarities to those of younger children. On conceptual tasks, impulsives were less adept at higher level conceptual skills than reflective children. On the Klausmeier task, impulsives performed less well

when required to understand principles (the relationship between concepts), they demonstrated less capacity compared to reflectives for problem-solving, and also performed less well when required to cognitively evaluate examples and nonexamples of the concept of tree. Each of these skills reflects higher stages of conceptual development within the Klausmeier theory, and it would appear impulsives, compared to reflectives, are less inclined to be able to process information at the formal level of conceptual development. The Vygotsky Concept Formation Test yielded consistent findings with the Klausmeier assessment in that reflective children generally performed significantly better demonstrating a capacity for higher levels of conceptual processing and less inclination to use vague, unstable bonds associated with the Vygotskian Phase II of conceptual development.

Summary

The conceptual system is a means through which complexities of our physical and social environment can be reduced into smaller categories of facilitate ease of interpretation and understanding. It has been hypothesized in this study that conceptually impulsive children conceptualize at lower levels of conceptual development than do reflective children. At the beginning of the thesis two models of conceptual development are presented both of which are based on stages of conceptual development. Klausmeier's concrete, identity,

classificatory, and formal stages were discussed as were the Vygotskian stages including Phase I, syncretic thinking (trial and error stage, visual field stage, regrouping stage), Phase II, thinking in complexes (associative complex stage, collective complex stage, chain complex stage, diffuse complex stage, pseudo-complex stage), Phase III, conceptual thinking (maximally similar grouping stage, potential concept stage, true concept stage). Functions relevant to achieving these various conceptual stages are attending, differentiating or discriminating discrete elements in the environment, and remembering, and adding to these functions, generalizing, and hypothesizing and evaluating at later stages of development. Essentially, a shift from reliance on perceptual elements which bind the individual to subjective perceptual impressions in processing information to an ability to utilize cognitive processes while inhibiting the perceptual salience occurs at later stages of conceptual development.

The focus of the review of the literature was on conceptual tempo. Individuals with an impulsive conceptual tempo have been found to have poor academic achievement, to be more aggressive, over-controlled, constricted, dogmatic, having little tolerance for complexities, demonstrate rigid behavior, are over-confident in reacting, less able to integrate information as necessary to solve a conceptual problem. A review of literature regarding hierarchies of dimensional preferences relating to perceptual inclinations of children of various ages was also presented.

The subjects of the study consisted of sixty grade four students from the Edmonton Public School System ranging in age from nine years, two months to ten years, eleven months. For all subjects, I.Q. information was already available on file resulting from the Canadian Cognitive Abilities Test which had been administered by the schools several months previously. The Matching Familiar Figures Test was used to distinguish an impulsive and reflective group. The Vygotsky Concept Formation Test and the Klausmeier Conceptual Learning and Develoment Assessment, Series IV: Tree were administered as measures of conceptual level of functioning. A Dimensional Preference Test was also administered.

The general hypothesis governing the study was that reflective children would perform better than impulsive children on the conceptual tasks and would demonstrate dimensional preferences for dimensions which occur earlier in the developmental hierarchy. Specific hypotheses were: (1) that impulsive children would choose colour significantly more frequently than reflective children when colour and form were presented as alternatives from which to choose, impulsive children would also choose colour more frequently than reflective when colour and number were paired as alternatives, and impulsive children would choose form more frequently than reflective children when form and number were paired; (2) that impulsive subjects, compared to reflective subjects, on the Vygotsky Concept Formation Test would make significantly fewer correct

moves, need more clues, revert to incorrect strategies more frequently, would tend to use more uncommon systems, would score lower when the number of uncommon systems employed was subtracted from the number of common systems employed, and would use multiple systems less often to solve the conceptual task; (3) that impulsive children would have significantly lower scores compared to reflective children on all three booklets of the Klausmeier Conceptual Learning and Development Assessment and would score lower in each of the sub-sections of (a) classificatory level functioning, (b) understanding taxonomic relations, (c) problem-solving skills, (d) understanding principles, (e) discriminating attributes, (f) evaluating examples and nonexamples, (g) understanding principles, (h) vocabulary relevant to the concept of tree.

The hypotheses were tested by means of t-tests to ascertain if significant differences between impulsive and reflective groups existed on each of the measures and stepwise regression with cross validation was also used to assess which of the variables acquired the greatest power in defining group membership (impulsive/reflective).

Results of the study confirmed the three stated hypotheses to a certain extent in the following manner. For the Dimensional Preference Test significant findings were apparent for only the last condition of the task, namely when form and number were paired. Impulsives chose form significantly more frequently, while reflectives chose number significantly more frequently. No

significant differences were found from colour-form or colour-number combinations. Hierarchies reported in the literature suggest colour is the earliest appearing dimensional preference, then form, then number. When the latter two were paired, presumably requiring the greatest perceptual discriminability of all the pairings presented, impulsives resorted to the earlier dimension.

Mixed findings were similarly apparent regarding the second hypothesis related to the Vygotsky Concept Formation Test. The number of correct moves made by reflective subjects were significantly greater than those of impulsive subjects, while impulsive subjects made significantly more reversions to incorrect strategies and there was also some support indicating that impulsives tend to use uncommon strategies reflecting the earlier stage of conceptual development (Phase II, thinking in complexes).

For the Klausmeier task, relating to the third hypothesis stated, again, reflective children demonstrated higher levels of conceptual skill in that they achieved significantly better performance on the Klausmeier task in understanding principles, in problem-solving skills and in evaluating examples and nonexamples of the concept of tree. No significant differences were apparent in other skills assessed by the test such as discriminating attributes, taxonomic relations, relevant vocabulary pertaining to the concept of tree.

In summary, there do appear to be significant differences between impulsive and reflective children in terms of their capacity to demonstrate

conceptual abilities in solving conceptual problems. While present results suggested that no differences in functions of attending and discriminating appear between impulsive and reflective children, impulsives appeared less adept at the cognitive functions of understanding principles and evaluating or hypothesizing in order to problem-solve. These functions, according to Klausmeier's and Vygotsky's theory are requisites for later stages of conceptual development. In addition, results of the Dimensional Preference Test suggested that some differences between impulsives and reflectives occur in their manner of responding to perceptual stimuli.

Klausmeier's theory of concept formation emphasizes learning or environmental experience as a primary influence in determining level of conceptual development. Similarly, Vygotsky's theory of concept formation emphasizes experience as a necessary requisite for conceptual development. In turn, conceptual development is a determinant of an individual's general level of cognitive development. In contrast, other theorists such as Piaget postulate the converse in that levels of conceptual development are determined by cognitive "readiness" which is a function of maturation. The argument is a chicken and egg one for which there is no answer. Regardless of this, it is clear that learning plays a significant role in cognitive and conceptual development whether or not "readiness" is a prerequisite for the learning.

The results presented in this study illustrate conceptual differences between impulsive and reflective children, and it is conceivable that impulsive children may be limited in their capacity to accommodate various concepts as presented in the educational curriculum. What concept formation seems to require is convergent thinking whereby masses of information are systematically organized into smaller, simplified patterns to facilitate understanding. Impulsive children appear to be less adept at the cognitive processes of combining concepts and evaluating in the course of problem-solving, and further seem impelled by perceptual salience within their environment. They appear less able to inhibit their perceptual response to salient dimensions long enough to utilize cognitive processes and, consequently, are prone to conceptual errors. In addition, impulsives are less systematic in their conceptual strategies.

The literature review on conceptual tempo provided evidence that enforcing a response latency was not effective as a means of reducing errors, but that teaching efficient strategies for task solution was an effective means of reducing the error rate of impulsive subjects. It may be that impulsive children who have difficulty getting beyond the perceptual immediacy of their environment may not have efficient conceptual strategies, and perhaps these sequential step-by-step strategies need to be provided and explicitely taught with the introduction of each new concept.

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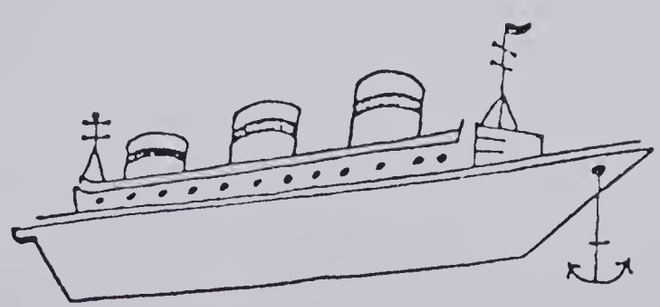
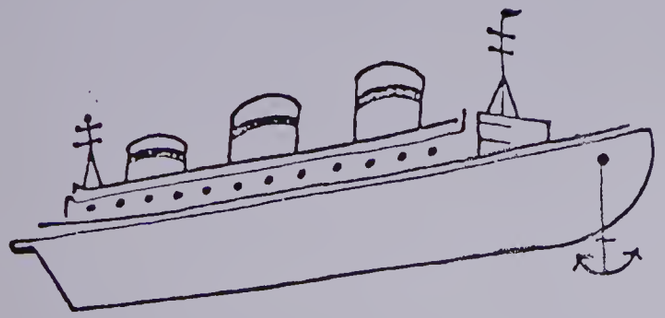
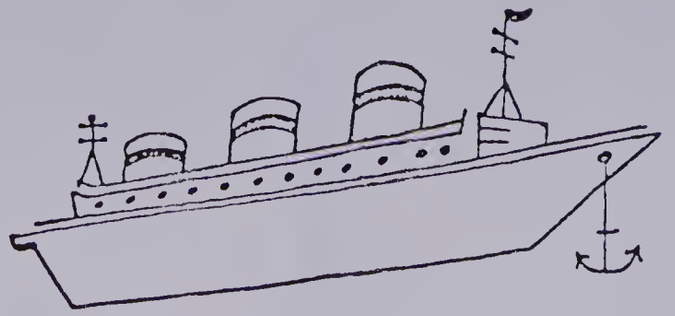
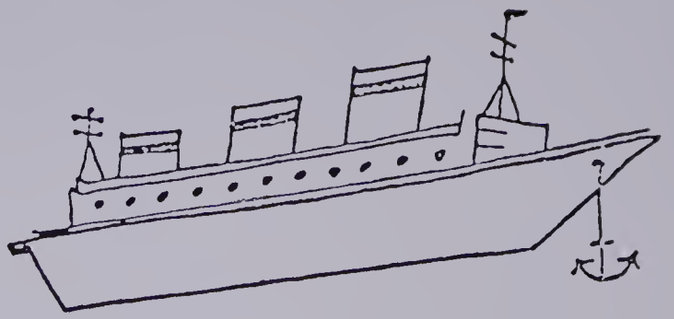
APPENDIX A

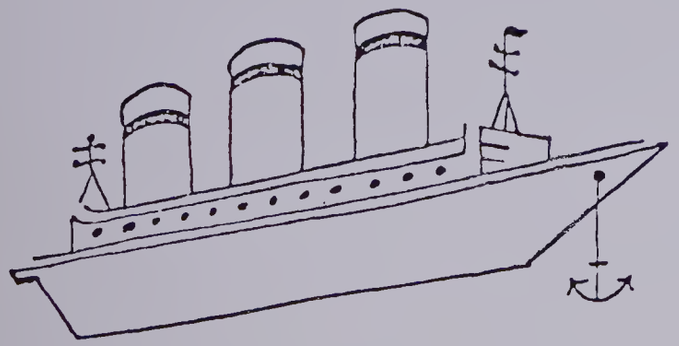
Sample Item for the Matching Familiar Figures Test

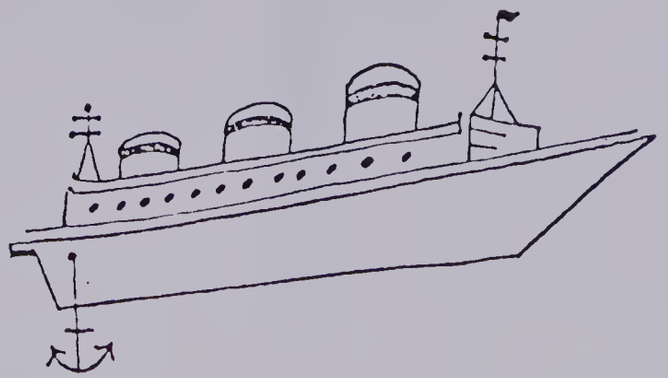


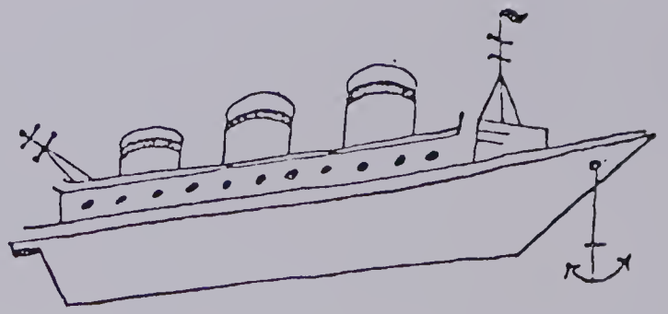












APPENDIX B

Scoring Sheet for the Matching Familiar Figures Test

Matching Familiar Figures Test

Name:

Birthdate:

Age:

Sex:

Practice

TRIAL	TIME	1	2	3	4	5	6	Errors
Flowers			X					
Ships			X					
Cowboys					X			
Graphs							X	
Soldiers			X					
Lions					X			
Leaves			X					
Dresses		X						
Lamps					X			
Beds					X			
Planes					X			
Babies				X				
Glasses						X		
Dogs				X				
TOTALS								

APPENDIX C

Penny Method of Administration

For the Vygotsky Concept Formation Test

Penny Method of Administration

There are three parts to the administration procedure for the Vygotsky Test. If a subject is able to complete Part 1 it is assumed that he would have been able to complete Part 2 and 3. If Part 1 is 'failed' then Part 2 is attempted. If Part 2 is failed also then Part 3 is attempted.

(a) Spread the 22 blocks (with 'names' downwards) before the subject in front of the sorting board. The blocks should be about equal distance from each other and randomly distributed.

The 'sorting board' is simply a piece of cardboard 6" X 20" divided into 5" X 6" sections. The four nonsense syllables LAG, CEV, BIK, MUR are printed on these sections.

(b) Say to the subject, placing emphasis on the words printed in capital letters: "Here are 22 different looking blocks. Though they all LOOK different they can REALLY be sorted into four different kinds. Each of these kinds has a name. This one (orange triangle Mur) is a Mur. (Place it, name upwards, in the Mur section of the sorting board.) The names of the others are Lags, Cevs, and Biks. Now, what I want you to do is to take the blocks ONE BY ONE and sort them into the four different groups. Don't turn the blocks up-side-down because the names are underneath. I suggest that you start by picking out the Murs and putting them here. (Indicate the Mur section of the sorting board). After each move I'll tell you if you are right or not (make sure subject

understands but do not give any clues, answers to leading questions, or analogies. Instructions may be repeated if required). Right, go ahead."

(c) Note relevant test behavior prior to first move, for example, preliminary sorting of the blocks into colour groups. Note similar behavior throughout test.

(d) Ascertain the subject's sorting system (whether by Form, Colour, Height, etc.) after each move. Enter the appropriate symbol(s) on the Record Form.

(e) If the subject sorts correctly and gives a correct reason say "That's right."

(f) If the subect sorts correctly but gives a wrong reason say, "That's in its right place, but you have given the wrong reason" If two consecutive moves are "right" for the *same* "wrong" reason then indicate why the reason is faulty. For example, if Height is used as the sorting system for two consecutive moves in the Bik section, then draw attention to the fact that the Cevs are also the same height.

(g) If the subject sorts incorrectly ascertain his system and move the block, name upwards, to the correct section of the board saying "That's not right because it's a ...(giving the correct name of the block). These corrections are regarded as 'clues' and should be appropriately indicated on the Record Form.

(h) Continue until all blocks have been sorted.

(i) Test is regarded as "solved" if five or more of the last moves are according to the correct system. If less than five moves are correct then repeat the test according to the following procedure: (i) Turn all blocks name downward. Ramdomize them. Place as they were place prior to the commencement of the test proper. (ii) Say to the subject "Now, just to make sure that you've got it right, I want you to try and put the blocks into their four groups just as they were before I mixed them up." (iii) No clues to be given. (iv) The subject is not penalised for confusing the names of the groups so long as the members of the four groups are correct. (j) If the test is still "failed" then proceed to Part 2 of the following procedure.

Part 2

(a) N.B. Part 2 should not be attempted before Part 1.

(b) The 22 blocks are grouped according to the correct principle, names downwards. The principle is explained to the subject in the following manner: "These are the tall, wide ones (indicating the Lags but not referring to them by name; these are the tall, narrow ones (the Murs); these are the flat, wide ones (the Biks); and these are the flat, narrow ones (the Cevs)."

(c) Allow the subject to look at the blocks for approximately 15 seconds.

(d) Say to the subject: "Now I'm going tc mix them up and when I have finished I want you to put them into their groups JUST AS THEY ARE NOW."

(e) Ramdomize the blocks slowly.

(f) Say to the subject: "Right, go ahead."

(g) For adequate performance the blocks must be grouped 100 percent correctly. No clues are to be given. Record relevant test behavior and the number and type of errors if his performance is adequate

(h) If the subject failes on this section of the test then proceed to Part 3 administration.

Part 3

(a) N.B. Part 3 should not be attempted before Part 2.

(b) The blocks are placed in random order in front of the subject. The sorting board is removed.

(c) Say to the subject: "I'll show you another way that is can be done." (Separate the blocks into five groups according to colour. Do not refer to "colour").

(d) Allow subject to look at the blocks for approximately 15 seconds.

(e) Say to the subject: "Now I'm going to mix them up and when I'm finished I want you to put them into the five groups JUST AS THEY ARE NOW."

(f) Randomize the blocks slowly.

(g) Say to the subject: "Right, go ahead."

(h) As for (g) in Part 2.

(i) If the subject fails on this section of the test then bring the test situation to a close. If he succeeds then proceed as follows. Say to the subject: "Now I'll show you another way it can be done" (Separate the blocks into six groups according to Form. Do not refer to "form" or "shape" etc.).

(j) As for (d), (e), (f), (g), and (h) above except that "six" is substituted for "five" in (e).

(k) If the subject fails on this section of the test then bring the test situation to a close. If he succeeds then proceed with: (i) Height - 2 groups; (ii) Width - 2 groups; (iii) Height and Width combined - the "correct" system - 4 groups. Procedure is the same except for the necessary alterations to (c) and (e) above.

APPENDIX D

Vygotsky Concept Formation Test
Record Sheet

Vygotsky Record Sheet

Name:

Age:

Sex:

Date:

Move No.	System	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

APPENDIX E

Vygotsky Concept Formation Test
Tabulation Sheet

Vygotsky Tabulation Sheet

Name: Age:

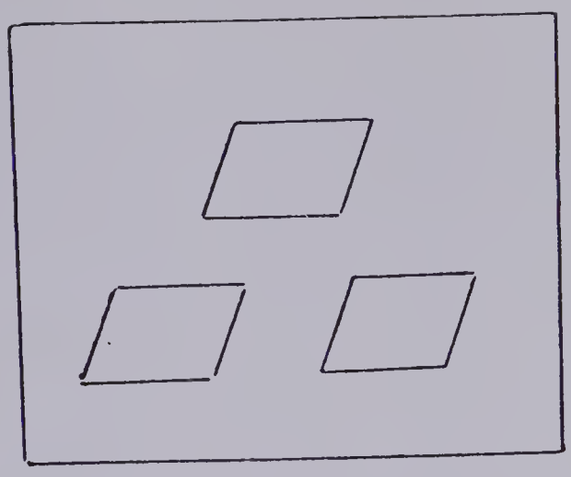
Sex: Date:

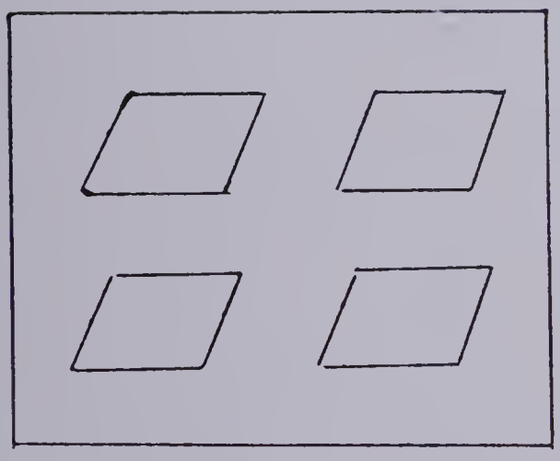
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
H																						CM
W																						
Sa																						Clues
F																						
C																						Reversions

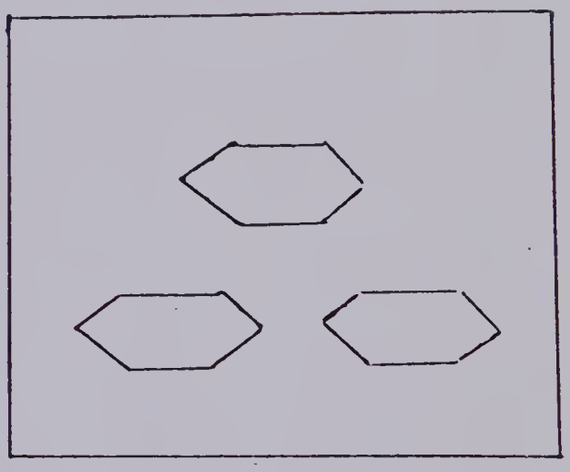
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
f																						M:S
M																						
E																						C:U Moves
?																						
M^F																						C:U System
P																						
M^f																						

APPENDIX F

Dimensional Preference Task
Sample Item







form-number dimension
(all geometric shapes are the same colour)

APPENDIX G

Dimensional Preference Task

Scoring Sheet

Dimensional Preference
Scoring Sheet

		C - F	C - N	F - N
Colour/Form	1			
	2			
	3			
	4			
	5			
Colour/Nbr.	1			
	2			
	3			
	4			
	5			
Form/Nbr.	1			
	2			
	3			
	4			
	5			

APPENDIX H

Klausmeier Conceptual Learning and Development, Series IV: Tree

Sample Items from Booklets

B, C, D

1. The thing on the left has a certain kind of stem. Put an X on the thing on the right that has the same kind of stem.

Stop

Klausmeier CLD Assessment, Series IV: Tree
Sample Item from Booklet B

1.

Tree X

Tree Y

Suppose that you have to choose a tree to plant in your yard. The tree must be planted where it will get little water. Tree X has many branches, but few roots. Tree Y has few branches, but many roots. Which tree should you choose?

a. Tree X
b. Tree Y
c. They would grow equally well
d. It is impossible to tell
e. I don't know

Stop

Klausmeier CLD Assessment, Series IV: Tree
Sample Item from Booklet C

1. Below are four things. Put an X on the one that is different from the other three.

Stop

Klausmeier CLD Assessment, Series IV: Tree
Sample Item from Booklet D